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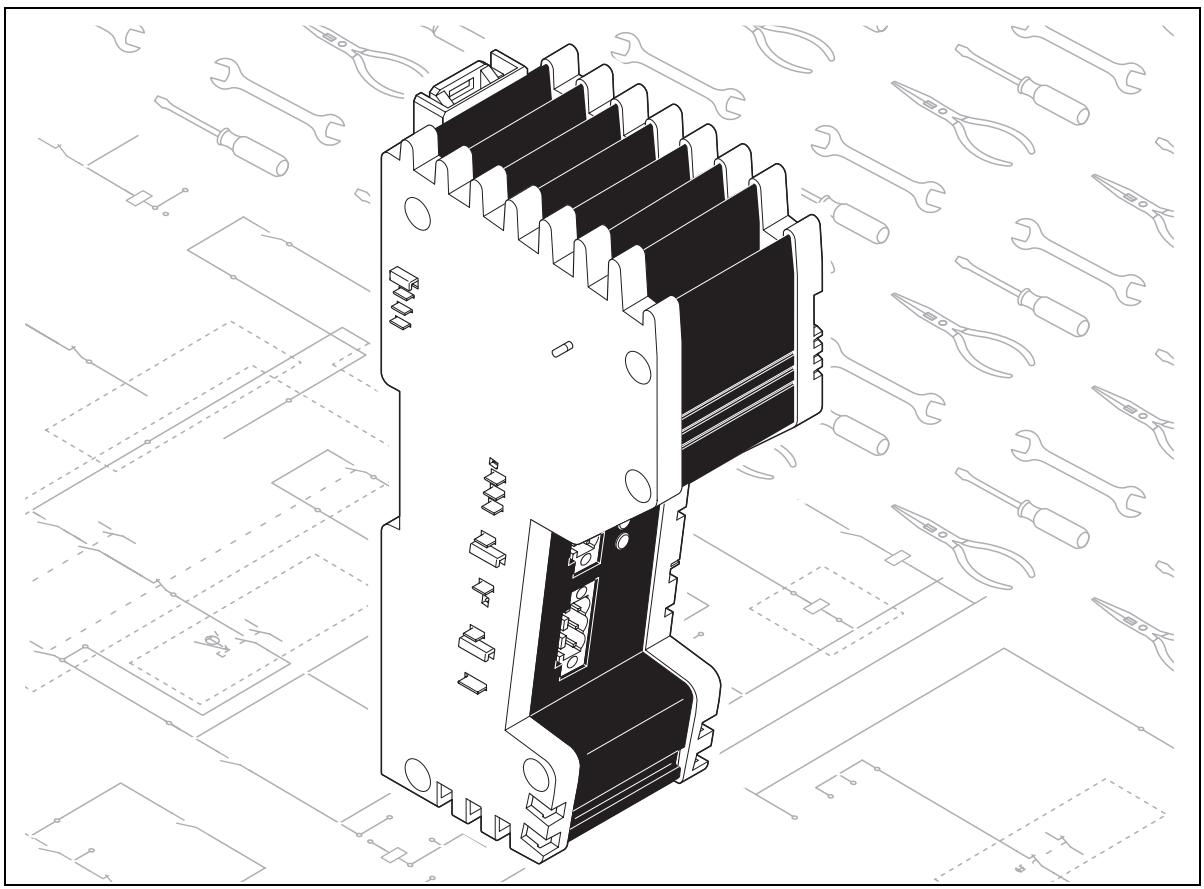
User Manual

Inline Servo Amplifier for DC Motors With Brushgears

Designation: UM EN IB IL DC AR 48/10A

Order No.: 26 99 19 2



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This user manual is valid for:

IB IL DC AR 48/10A	28 19 28 6

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1 Fields of Application and Functions

This user manual is only valid in association with the IB IL SYS PRO UM E User Manual or the Inline System Manual for your bus system.

1.1 Short Description

The IB IL DC AR 48/10A Inline servo amplifier is a universal speed or torque controller with a power output stage for permanently excited DC motors with brushgears with a power consumption of up to 450 W.

The Inline servo amplifier has a 4 quadrant function, i.e., it supplies power back to the power supply unit when the brake function is used (see page 1-11).

1.2 Possible Fields of Application

The Inline servo amplifier is used under the following conditions:

– Torque controller or speed controller
– Permanently excited DC motors with brushgears
– Nominal voltages of 12 V DC to 48 V DC
– Power consumption of up to 450 W
– Motor current of up to 10 A

Typical Application

The Inline servo amplifier can be used as an individual drive (Figure 1-1) or in a modular multi-axis positioning control system (Figure 1-2).

In the multi-axis positioning control system the Inline servo amplifier is controlled via the IB IL POS 200 (-PAC) positioning CPU.

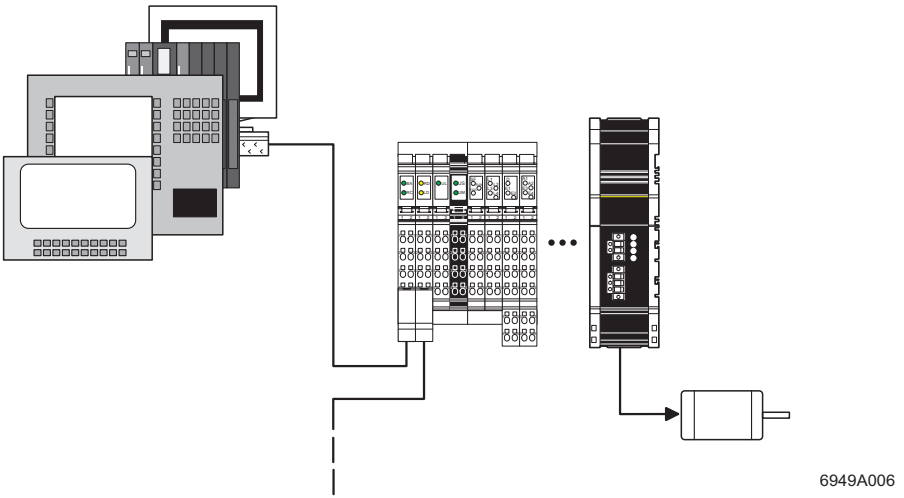

Figure 1-1 Use of the IB IL DC AR 48/10A as an individual drive

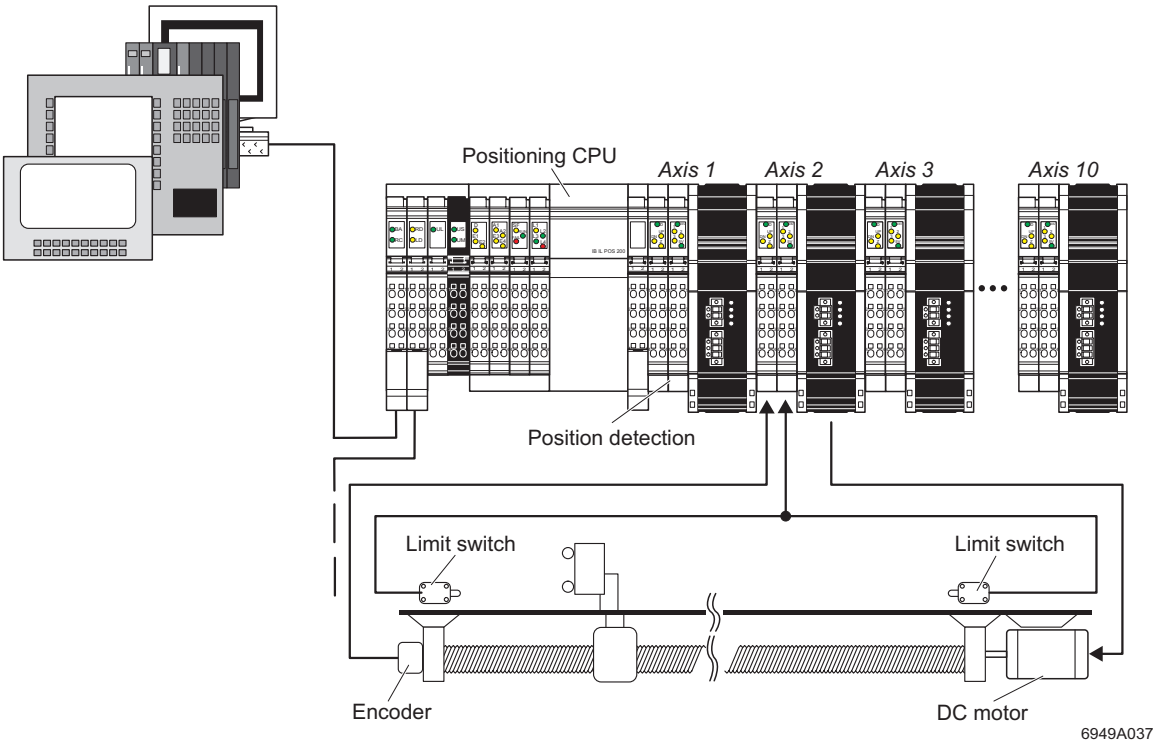

Figure 1-2 Use of the IB IL DC AR 48/10A in a modular multi-axis positioning control system

1.3 Function

The Inline servo amplifier is designed as an Inline terminal. It can thus be easily operated in any control system and can be used to create a distributed positioning control system simply by mounting Inline positioning terminals side by side (e.g., positioning CPUs, position detection terminals, and other digital and analog output terminals).

LED diagnostic and status indicators enable quick local error diagnostics.

The following functions are available:

– Speed control without IxR compensation (voltage control)
– Speed control with IxR compensation
– Torque control (current control)

4 quadrant mode

The IB IL DC AR 48/10A Inline servo amplifier autonomously sets the speed or the torque of the connected motor to the desired speed value/torque value, which it receives via Inline in the form of process data (4 quadrant mode) (see page 1-11).

DC motors

A special feature of the Inline servo amplifier is that it can be used to create simple speed-controlled drives using cost-effective DC motors with brushgears, without the need for a rotary encoder system (e.g., on the motor shaft).

This method relies on a particular aspect of the behavior of DC motors: their speed changes in proportion to the supply voltage. In this way the speed can be indirectly controlled via the motor voltage.

IxR controller

In addition, the Inline servo amplifier uses an IxR controller, which compensates for speed variations caused by the changing load.

Operation, setting the operating mode, and parameterization should be compatible with the "DRIVECOM profile 22" protocol.

Safety equipment

The IB IL DC AR 48/10A uses safety equipment to prevent:

– Overcurrent
– Surge voltage and undervoltage
– Overtemperature
– Short circuit between motor cables
– Short circuit against the voltage supply

Voltage and current supply

The IB IL DC AR 48/10A Inline servo amplifier is based on digital controllers. Its task is to provide current and voltage values, which can be used to directly operate DC motors with brushgears.

The level of the current and voltage values depends on the various functions, which the Inline servo amplifier carries out in the individual operating modes. The power supply of 12 V DC to 48 V DC and 0 A to 10 A is supplied to the Inline servo amplifier via connection U_S.

1.3.1 Speed Control Without IxR Compensation (Voltage Control)

In this function, the IB IL DC AR 48/10A Inline servo amplifier acts as a speed controller (4 quadrant mode) without external feedback (e.g., tachometer signal) (see also "4 Quadrant Mode" on page 1-9).

This method relies on a particular feature of DC motors, whereby the speed increases in direct proportion to the motor voltage. The Inline servo amplifier only controls the motor voltage (positive and negative).

If IxR compensation is not activated ("IxRCompensation" parameter = 0, index $010B_{hex}$), the Inline servo amplifier compares the actual motor voltage (measured at the output terminals of the Inline servo amplifier) with the voltage that is required for the desired speed and corrects it accordingly. The motor voltage and speed are therefore not affected by fluctuations in the supply voltage.

Please note that the supply voltage for the Inline servo amplifier must be approximately 10% higher than the voltage that it can supply to the motor.

1.3.2 Speed Control With IxR Compensation

When the speed is controlled via the motor voltage, the speed changes in the event of load fluctuations. The speed decreases at a constant motor voltage with increasing load, as the ohmic resistors in the motors do not allow the current to increase too high in proportion with the increasing load.

The Inline servo amplifier reduces these speed variations through the use of "IxR compensation". This function increases the motor voltage in proportion to the current increase, which is caused by the increasing load.

Total accuracy is limited due to the indirect speed control process. The extent to which speed variations caused by load fluctuations can be limited depends on the dynamic response of the load fluctuations and on the structure of the motor.

In general, load fluctuations can be reduced by up to 90% by activating IxR compensation.

1.3.3 Torque Control (Current Control)

The IB IL DC AR 48/10A Inline servo amplifier uses this function to autonomously set the torque of the connected motor to the desired torque value, which it receives via Inline in the form of process data (4 quadrant mode, see page 1-9).

This is carried out using a current control, for which the Inline servo amplifier provides feedback by measuring the motor current.

The torque control is used if the motor must produce a constant force, e.g., to wind a spring or to supply a liquid at constant pressure.

With this function the drive behaves as follows: As long as the torque of the mechanics is less than the torque with which the Inline servo amplifier operates the drive, the drive speeds up (limited by the supply voltage). If the torque of the mechanics is greater, the drive slows down.

The desired torque is specified as a per thousand value of the nominal torque. So that the Inline servo amplifier can operate in this way, the nominal torque of the motor (not residual) is loaded as an additional parameter.

1.3.4 Method of Operation of the Output Level

Pulse wide modulation

The Inline servo amplifier generates the desired motor voltage or the desired motor current (for torque control) using **P**ulse **W**ide **M**odulation (PWM).

The power supplied to the motor is switched. The mean motor voltage value is controlled by the duration of the pulses.

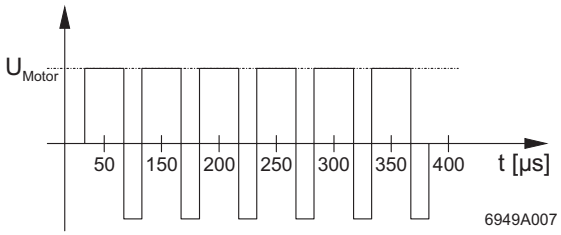

Figure 1-3 Pulse wide modulation (PWM)

The pulses are generated with a set frequency of 20 kHz.

1.3.5 Operating Modes of the Output Level

The output level of the Inline servo amplifier operates with a bipolar PWM signal (see Figure 1-4). A high level of efficiency can thus be achieved for motors with a higher current requirement.

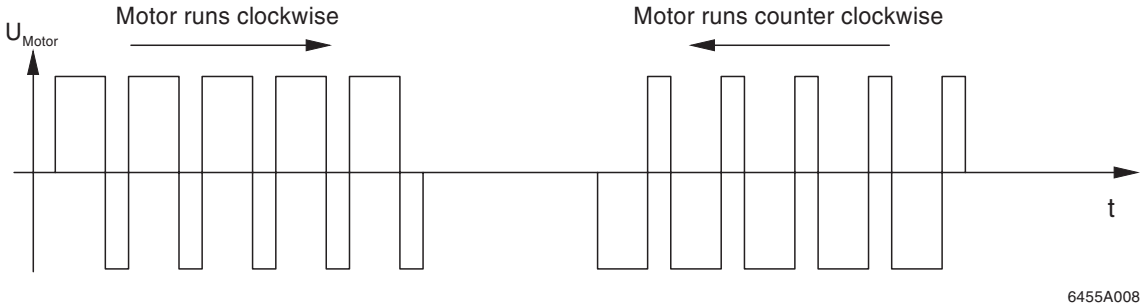

Figure 1-4 4T mode (4 transistor mode)

When operating motors with low inductance and a small current requirement, this mode can lead to an undesirably high temperature rise on the motor at low speeds.

In this case the motor should be switched to 2T mode, whereby the output level operates with a unipolar signal (see Figure 1-5). Only positive or negative pulses are sent to the motor depending on the direction of rotation.

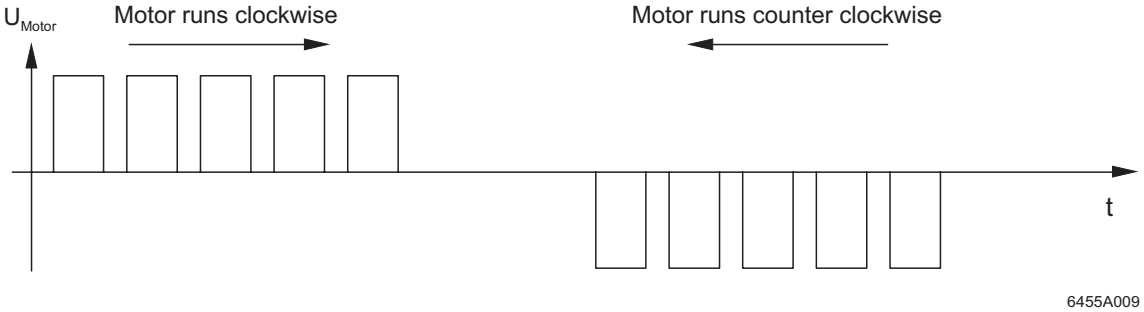

Figure 1-5 2T mode (2 transistor mode)

1.3.6 4 Quadrant Mode

The Inline servo amplifier supports 4 quadrant mode.

The name "4 quadrant mode" is derived from the representation of the possible motor operating states in a speed/torque/coordinate system: The possible motor torque and motor speed operating states are displayed in the four quadrants (see Figure 1-6).

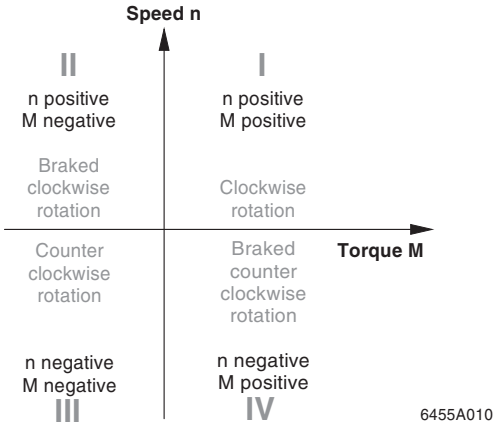

Figure 1-6 Speed/torque/coordinate system

In counter clockwise and clockwise rotation, the torque operates in the direction of speed, i.e., the motor is driven (quadrant I and III). In braked counter clockwise and clockwise rotation, the torque operates in the opposite direction to speed, i.e., the motor brakes are applied.

– Quadrant I: Clockwise rotation
  Motor torque M operates in the direction of rotation of the motor shaft.

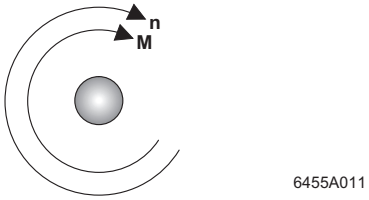

Figure 1-7 Clockwise rotation

– Quadrant II: Braked clockwise rotation
  The torque operates in the opposite direction of rotation; the motor brakes are applied.

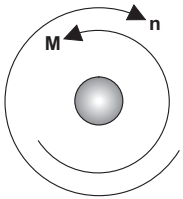

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Figure 1-8 Braked clockwise rotation

– Quadrant III: Counter clockwise rotation
  The torque operates in the direction of rotation; this is the opposite of the direction of rotation in quadrant I.

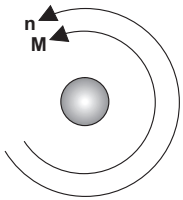

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Figure 1-9 Counter clockwise rotation

– Quadrant IV: Braked counter clockwise rotation
  The torque operates in the opposite direction to the counter clockwise rotating shaft.

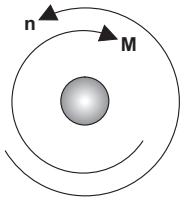

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Figure 1-10 Braked counter clockwise rotation

Regenerative Sequences

When the motor brakes are applied, the motor releases kinetic energy. In 4 quadrant mode, the generated kinetic energy is fed back into the intermediate circuit of the power supply as electrical energy, i.e., at the power supply unit. If no other devices (e.g., other Inline servo amplifiers) draw from this energy, the power in the intermediate circuit can increase to a value, which can damage electrical circuits or trigger a surge voltage shutdown in electronic power supply units.

As minor fluctuations are normal, the Inline servo amplifier and the power supply unit must be able to withstand a higher power level than the maximum supplied by the power supply unit. For the IB IL DC AR 48/10A this is 60 V.

The Inline servo amplifier has a voltage monitoring function, which switches off the motor if the fixed voltage threshold is exceeded.

Brake chopper

If voltage overshoots caused by energy feedback have to be taken into consideration, a module must be installed at the power supply to reduce the surge voltage ("brake chopper").

Brake choppers (1 in Figure 1-11) load the voltage supply with a resistance when an adjustable voltage value is exceeded and convert the excess energy into heat.

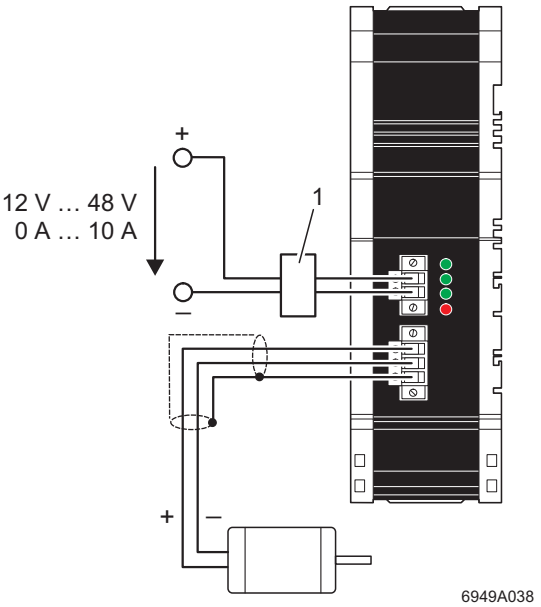

Figure 1-11 Connection diagram

1.3.7 Function of the Controller in the Device

Speed specification

In "Speed specification" mode two controllers are cascaded in the device:

– Speed controller
– Current controller

If a control parameter needs to be adjusted, both controllers must be parameterized in this operating mode.

Torque specification

IxR compensation affects the speed controller. In "Torque specification" mode only the current controller is active. If a control parameter needs to be adjusted, only the current controller must be parameterized in this mode.

The controllers are set using standard parameters so that various applications can be carried out without having to modify the parameterization.

The behavior of motors in machines greatly depends on the dynamic behavior of the mechanics. If you observe irregular motor operation, adjust the control parameters. Instructions on how to proceed are provided below.

Adjusting Control Parameters

Both controllers in the Inline servo amplifier (current controller and speed controller) are PI controllers, i.e., proportional controllers with additional integral action. They have no derivative action.

The default values of the control parameters are preselected in such a way that they already provide good results in most applications. In special cases it may be necessary to adjust the control parameters to the motor and drive used. To optimize the control parameters, proceed as follows (see Section A, "Parameters"):

- Enable operation (speed setpoint = 0).
- Increase the KI value of the current controller as far as the stability limit.
- Decrease the KI value of the current controller by 20%.
- Increase the KP value of the current controller as far as the stability limit.
- Decrease the KP value of the current controller by 20%.
- Increase IxR compensation as far as the stability limit.
- Decrease IxR compensation by 20%.
- Increase the KI value of the speed controller as far as the stability limit.
- Decrease the KI value of the speed controller by 20%.
- Increase the KP value of the speed controller as far as the stability limit.
- Decrease the KP value of the speed controller by 20%.

Optimization of the control parameters

The dynamic properties of the drive for stable control behavior should already have been further improved. In order to further optimize the control parameters, a jump function for the desired speed may be useful.

It is advisable to record the speed behavior, e.g., using a tachometer generator and an oscilloscope. Continue to vary the parameters for the speed controller until the time curve of the speed actual value corresponds as closely as possible to the time curve of the speed setpoint, whereby the control circuit must remain stable on each load.

When using jump functions, observe the settings for the acceleration and braking ramp as well as the value of the motor current limit.

2 Installing the Inline Servo Amplifier

2.1 DRIVECOM Compatibility

The IB IL DC AR 48/10A Inline servo amplifier has the same functions as INTERBUS DRIVECOM profile 22. It therefore has two function groups:

– Speed function group
– Torque function group

The "ModeSelectionCode" parameter (index 6060_{hex}) specifies which function group should be active.

In addition, each parameter is assigned a special index (see "Parameters" on page A-1).

The Inline servo amplifier is set to "Speed specification" mode by default. In this operating mode, the speed setpoint is specified in revolutions per minute via process data word 1 (or alternatively as a percentage, which can be converted into a "speed setpoint" using the "speed reference value").

Once the speed setpoint has executed two factor functions, the speed and the acceleration/delay are limited (see Figure A-1 on page A-2).

Per thousand function

The limited setpoint is then sent to the speed controller. As the controller operates with per thousand values, all input and output values for the speed controller execute a per thousand function.

In order to use per thousand functions, the Inline servo amplifier requires the following motor reference values in the form of parameters:

– Nominal speed
– Nominal voltage
– Nominal current

The Inline servo amplifier uses a particular feature of DC motors for the speed control function, whereby the speed responds in proportion to the motor voltage. The speed controller indirectly controls the speed via the motor voltage.

2.2 Local LED Diagnostic and Status Indicators

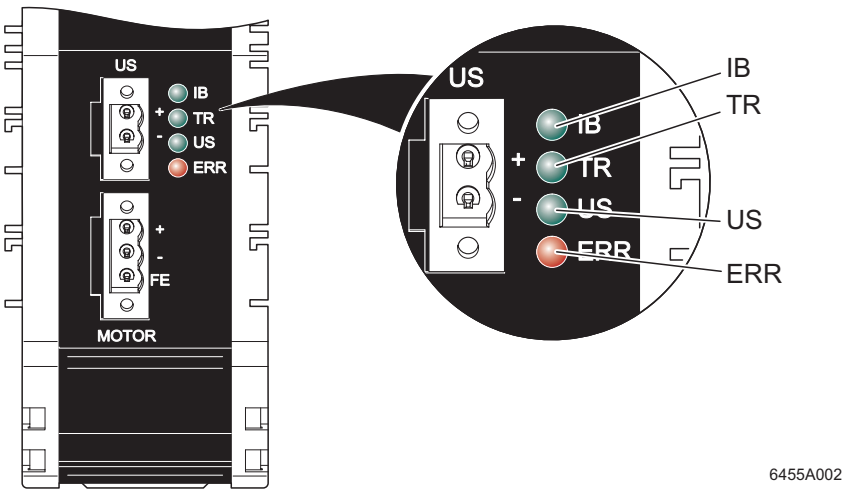

Figure 2-1 Local LED diagnostic and status indicators on the IB IL DC AR 48/10A

Table 2-1 Meanings of the LED diagnostic and status indicators

Des.	Color	Meaning
IB	Green LED	Diagnostics
	ON	Bus active
	Flashing	
	0.5 Hz	Communications power present, bus not active
	2 Hz	Communications power present, bus active, I/O error
	4 Hz	Communications power present, terminal before the flashing module failed, terminal behind the flashing module not part of the configuration frame
	OFF	Communications power not present, bus not active
TR	Green LED	PCP active
	ON	PCP messages being transmitted to the Inline servo amplifier
	OFF	No transmission of PCP messages
US	Green LED	Supply voltage of the power section (see Figure A-4 on page A-5)
	ON	Supply voltage for the output stage is more than 75% of the nominal voltage of the power supply
	OFF	Supply voltage for the output stage is less than 75% of the nominal voltage of the power supply
ERR	Red LED	Error (see Figure A-8 on page A-7)
	ON	An error has occurred (corresponds to bit 3 in the status word) The cause of the error can be read in the "ErrorCode" parameter (index $603F_{hex}$).
	OFF	No error

2.3 Mounting and Removing the Inline Servo Amplifier

Do not replace terminals while the power is connected.

Before removing or mounting a terminal, disconnect the power to the entire station. Make sure the entire station is reassembled before switching the power back on.

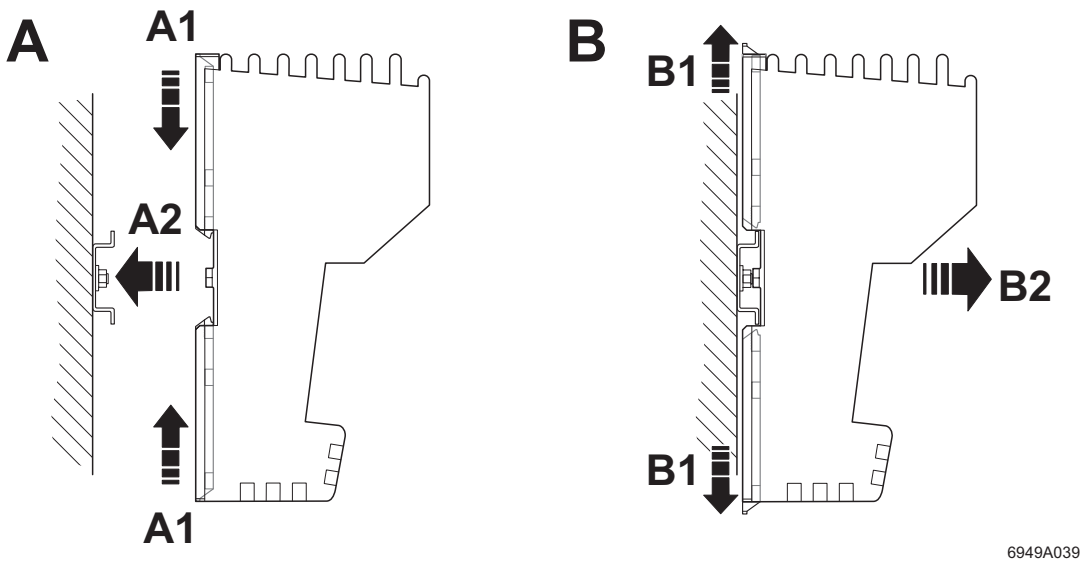

Figure 2-2 Mounting and removing the Inline servo amplifier

Mounting the Inline Servo Amplifier (Figure 2-2, A)

- Before snapping on the Inline servo amplifier, remove the adjacent connectors of the next Inline terminal on the left.
- Press the upper and lower snap-on mechanisms towards the center of the module (A) and snap the module vertically onto the DIN rail (B).

Ensure that the featherkeys and keyways on the adjacent terminals are securely interlocked.

Removing the Inline Servo Amplifier (Figure 2-2, B)

- Before removing the Inline servo amplifier, remove the adjacent connectors of the neighboring Inline terminals (left and right).
- Use a screwdriver to press the latches of the upper and lower snap-on mechanisms outward (B1).
- Remove the Inline servo amplifier from the DIN rail (B2).

2.4 Connecting the Inline Servo Amplifier

2.4.1 Terminal Assignment

The Inline servo amplifier has two COMBICON connectors for connecting the power supply and the motor. The connectors and the shield clamp are supplied as standard for connecting functional earth ground.

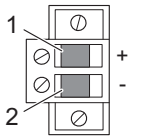

Figure 2-3 Terminal assignment for the power supply (US)

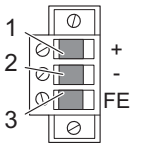

Figure 2-4 Terminal assignment for the motor (MOTOR)

Power Supply

Terminal Point	Assignment
1	U_S +
2	U_S –

Motor Connection

Terminal Point	Assignment
1	Motor +
2	Motor –
3	Functional earth ground (FE)

2.4.2 Connecting the Power Supply

Observe the polarity.

The polarity of the power supply must not be reversed.

The entire motor circuit is designed for direct voltage polarity. Do not mix up the plus and minus poles, as this can seriously damage the electronics.

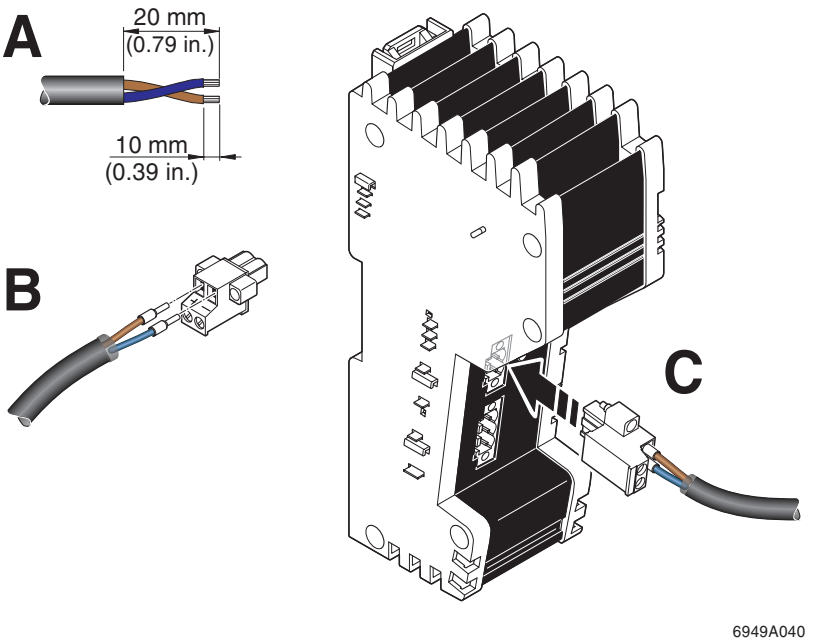

Figure 2-5 Connecting the power supply

- Strip the cable and the wires (Figure 2-5, A).
- Fit the stripped wire ends with ferrules.
- Insert the wires for the power supply in the corresponding terminal points on the 2-pos. COMBICON connector (Figure 2-5, B).
- Insert the 2-pos. COMBICON connector in the upper slot (US) on the Inline servo amplifier (Figure 2-5, C) and secure.

2.4.3 Connecting the Motor

Observe the polarity.

The polarity of the motor connections must not be reversed.

The motor must be connected via a two-wire **shielded** cable in order to prevent errors during signal transmission.

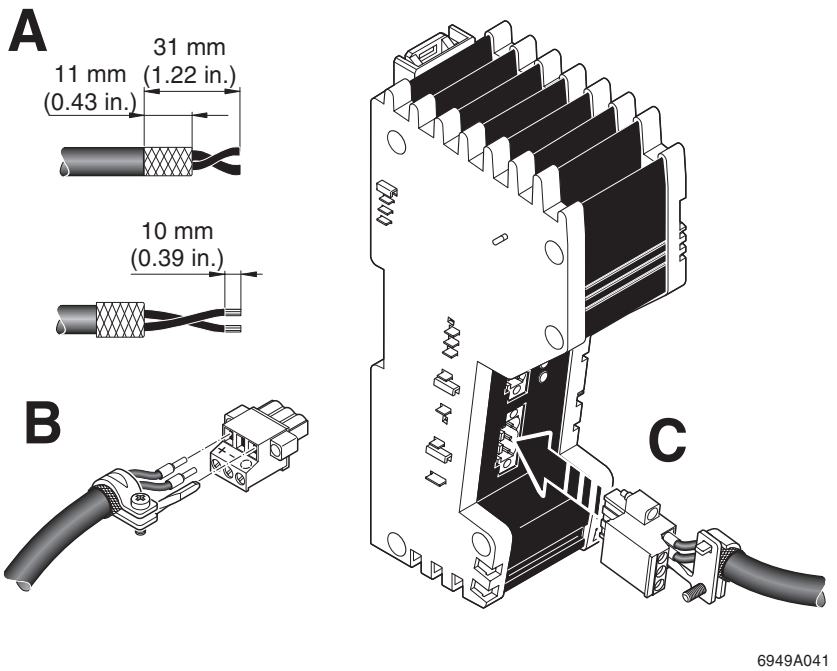

Figure 2-6 Connecting the motor

- Strip the outer cable sheath off the cable (Figure 2-6, A).
- Shorten the braided shield and place it around the outer cable sheath.
- Remove the protective foil.
- Fit the stripped wire ends with ferrules.
- Fasten the shield clamp to the cable.
  The shield clamp must be inserted in terminal point 3 on the connector.
  It simultaneously provides strain relief.
- Insert the wires for the motor connection in the corresponding terminal points on the 3-pos. COMBICON connector (Figure 2-6, B).
- Insert the 3-pos. COMBICON connector in the lower slot (MOTOR) on the Inline servo amplifier (Figure 2-6, C) and secure.

Notes on preventing errors

In order to prevent errors during signal transmission, please observe the following:

- Use a shielded cable to connect the Inline servo amplifier to the motor.
- Ground the Inline servo amplifier by connecting the DIN rail on which it is mounted to FE via the shortest possible route.
- Install the data and signal cables separately from the supply line and the motor connection cable.
- Make sure the data and signal cables are as short as possible.

- Do not install the Inline servo amplifier until you are certain that the power supply has been switched off for at least five minutes.

- First, connect only the Inline servo amplifier to the power supply.
  Do **not** connect the motor yet.
- Set the desired parameters and operating modes.
- Check whether the LEDs indicate normal operation (see "Local LED Diagnostic and Status Indicators" on page 2-2).
  If so, you can connect the motor.

2.5 Calculating the Supply Voltage

Please note that the supply voltage for the Inline servo amplifier must be approximately 10% higher than the voltage that it can supply to the motor.

2.6 Selecting Compatible Motors

The Inline servo amplifier is designed for operating DC motors with brushgears with permanent magnets.

Nominal voltage range

The nominal voltage range can be between 12 V DC and 48 V DC. The Inline servo amplifier supplies a maximum of 10 A to the motor, i.e., a motor with a nominal current of 3 A can start with a starting current of 10 A.

If you operate a motor with a nominal current of 10 A, it too only has a maximum starting current of 10 A. The starting torque of the Inline servo amplifier is lower for motors with a starting current of more than 10 A than for operation with a battery.

Temperature derating of the motor current

When operating larger machines at higher ambient temperatures, the temperature derating of the motor current must be observed. Figure 2-7 on page 2-11 provides information about the maximum available continuous motor current according to the ambient temperature of the Inline servo amplifier.

The specified values are provided for reference only and vary according to the installation space, the mounting position, and cooling air flow. The Inline servo amplifier can temporarily supply motor currents of up to 10 A at any ambient temperature. For larger motors in continuous operation at higher ambient temperatures, the internal fan is activated in order to cool the Inline servo amplifier. In the event of overtemperature (e.g., due to an overload) the power section of the Inline servo amplifier switches off automatically and indicates the error "Output level overtemperature" (see Figure A-6 on page A-6). The actual temperature of the output level can be read from the "DeviceTemperature" parameter (index 6015_{hex}).

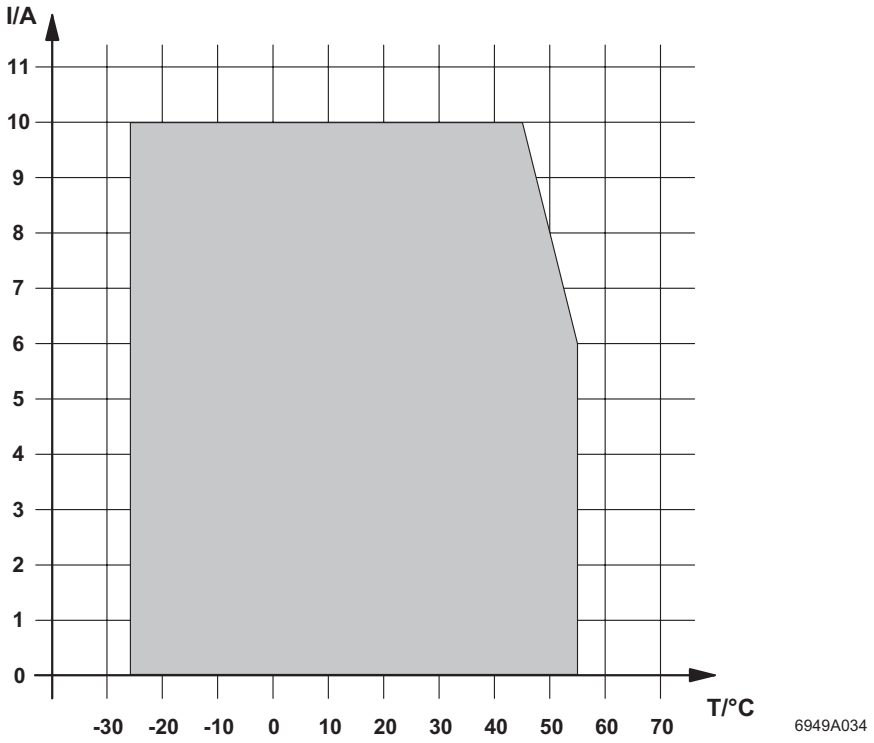

Figure 2-7 Working area of the Inline servo amplifier in open space

The connected motors should have a minimum inductance (see "Technical Data" on page B-1). Motors with a lower inductance (motors with transformerless winding) **cannot** smooth the switched motor voltage to a direct current. The AC component then causes a temperature rise at the motor coils.

Minimum nominal current

Motors operating on the Inline servo amplifier must have a minimum nominal current. If this value is not reached, the effectiveness of current detection is limited, and therefore also the effectiveness of the current controller.

In particular, in "Torque specification" mode the motor should have a nominal current of more than 100 mA. Smaller motors with a lower nominal current can also be operated in "Speed specification" mode but speed accuracy is limited.

3 Parameterization

3.1 Programming Data/Configuration Data

INTERBUS

ID code	$C3_{hex}$ (195_{dec})
Length code	02_{hex} (02_{dec})
Process data channel	32 bits
Input address area	2 words
Output address area	2 words
Parameter channel (PCP)	1 word
Register length (bus)	3 words

Other Bus Systems

For the configuration data of other bus systems, please refer to the corresponding electronic device data sheet (GSD, EDS) at www.phoenixcontact.com.

3.2 Inline Servo Amplifier From the Point of View of the Fieldbus

The Inline servo amplifier provides digital access to all the drive parameters and functions via the local bus interface, i.e., the Inline servo amplifier is only parameterized and controlled via the bus. There are no option for setting the resistance or other settings on the Inline servo amplifier.

The amplifier is controlled via fast, cyclic process data. In addition to specifying setpoints (e.g., desired speed value), this process data channel can also be used to execute various drive functions including:

– Enable
– Enable operation
– Disable operation
– Quick stop, etc.

At the same time, you can also read back actual values from the Inline servo amplifier via this channel, including:

– Actual speed
– Actual current
– Actual device state

Communication

The Inline servo amplifier communicates with the higher-level control system via the local bus as well as via the fast, cyclic process data channel and the acyclic parameter channel (PCP, **P**eripherals **C**ommunication **P**rotocol).

While process data is generally exchanged cyclically, the drive parameters can be read and written acyclically via the "Read" and "Write" PCP services. These services do not permanently store the parameters in the Inline servo amplifier.

Process data

Process data is time-critical status information that changes continually and must be continuously updated. This information must be transmitted at short regular intervals. It is transmitted via the process data channel.

Parameter data

Parameter data is data that seldom changes and must therefore only be transmitted when required. It is transmitted via PCP communication.

In the bus ring, the Inline servo amplifier occupies one word for the PCP channel and two process data words (not variable) for each data direction.

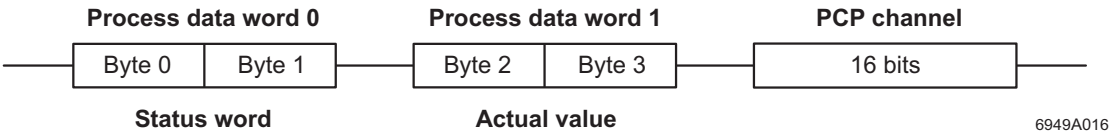

Figure 3-1 IN process data words

The contents of the IN process data words depend on the "INProcessDataDescription" parameter (index 6000_{hex}).

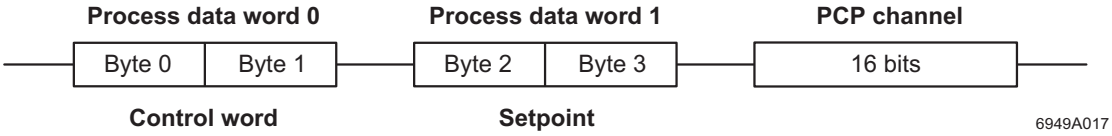

Figure 3-2 OUT process data words

The contents of the OUT process data words depend on the "OUTProcessDataDescription" parameter (index 6001_{hex}).

The contents of the process data words can be freely defined. Any parameter can be selected for transmission in the process data word. This is done via the "INProcessDataDescription" parameter (index 6000_{hex}) and the "OUTProcessDataDescription" parameter (index 6001_{hex}). The control word and status word are transmitted in process data word 0 by default.

Control word

The control word is used to remotely control the Inline servo amplifier between the individual operating states via the bus.

Status word

The current operating state can be read in the status word.

In addition, bits in the status word indicate:

– Whether there is a warning or an error
– Whether the speed or current limiting device is active
– Whether a setpoint has been reached (following a ramp function)

Depending on the operating mode, the speed setpoint or the torque setpoint is written to OUT process data word 1. An actual value is usually read from IN process data word 1.

PCP channel

All the parameters for the individual functions are written to or read from the PCP channel via specific indices. As parameter data seldom changes, it is sent via the PCP channel on which messages are only transmitted when required. Data is transmitted via PCP communication, whereby a message is sent and its index determines which parameter is addressed. For every parameter an access attribute specifies whether the parameter can be read or written.

Control via the Control Word/Status Word

The control word is used to change the operating state of the Inline servo amplifier via the bus. Figure 3-3 on page 3-8 illustrates this "remote control" sequence. The different operating states can only be reached in a specific sequence.

Once switched on, the device must first pass through the "Not ready to operate", "Start inhibit", "Ready to operate", and "ON" states to enter the "Operation enabled" state.

The next operating state is reached by setting/resetting the relevant bits in the control word. The Inline servo amplifier continuously indicates its operating state in the control word.

Control Word

Bit	Assignment	Remark
0	Switch on	Switch on the power section
1	Disable voltage	Voltage is switched off, active low
2	Quick stop	Execute the quick stop function, active low
3	Enable operation	Enable drive function
4	–	0
5	–	0
6	–	0
7	Reset error	Reset errors whose causes have been removed (see status word, bit 3)
8	–	0
9	–	0
10	–	0
11	Activate LowRuntime2	Activate LowRuntime2 instead of LowRuntime
12	–	0
13	–	0
14	–	0
15	–	0

All states are active high unless otherwise stated.

Status Word

Bit	Assignment	Remark
0	Ready to operate	See "Device Control States" on page 3-7
1	ON	
2	Operation enabled	
3	Error	
4	Voltage disabled	
5	Quick stop	
6	Start inhibit	
7	Warning	Warning present See "WarningCode" parameter (index $010D_{hex}$) on page A-13
8	Message	0
9	Remote	1 (parameters can be modified)
10	Setpoint reached	Defined setpoint (at the ramp generator output) has been reached (ramp has ended)
11	Limit value	**"Speed specification"** mode: speed limit active or current limit active **"Torque specification"** mode: current limit is active
12	–	0
13	–	0
14	–	0
15	–	0

Device Control States

The device control states are displayed in the status word by the following bit combinations:

Table 3-1 Device states

State	Bit 6 Start Inhibit	Bit 5 Quick Stop	Bit 3 Error	Bit 2 Operation Enabled	Bit 1 ON	Bit 0 Ready to Operate
Not ready to operate	0	X	0	0	0	0
Start inhibit	1	X	0	0	0	0
Ready to operate	0	1	0	0	0	1
ON	0	1	0	0	1	1
Operation enabled	0	1	0	1	1	1
Error	0	X	1	0	0	0
Error response active	0	X	1	1	1	1
Quick stop active	0	0	0	1	1	1

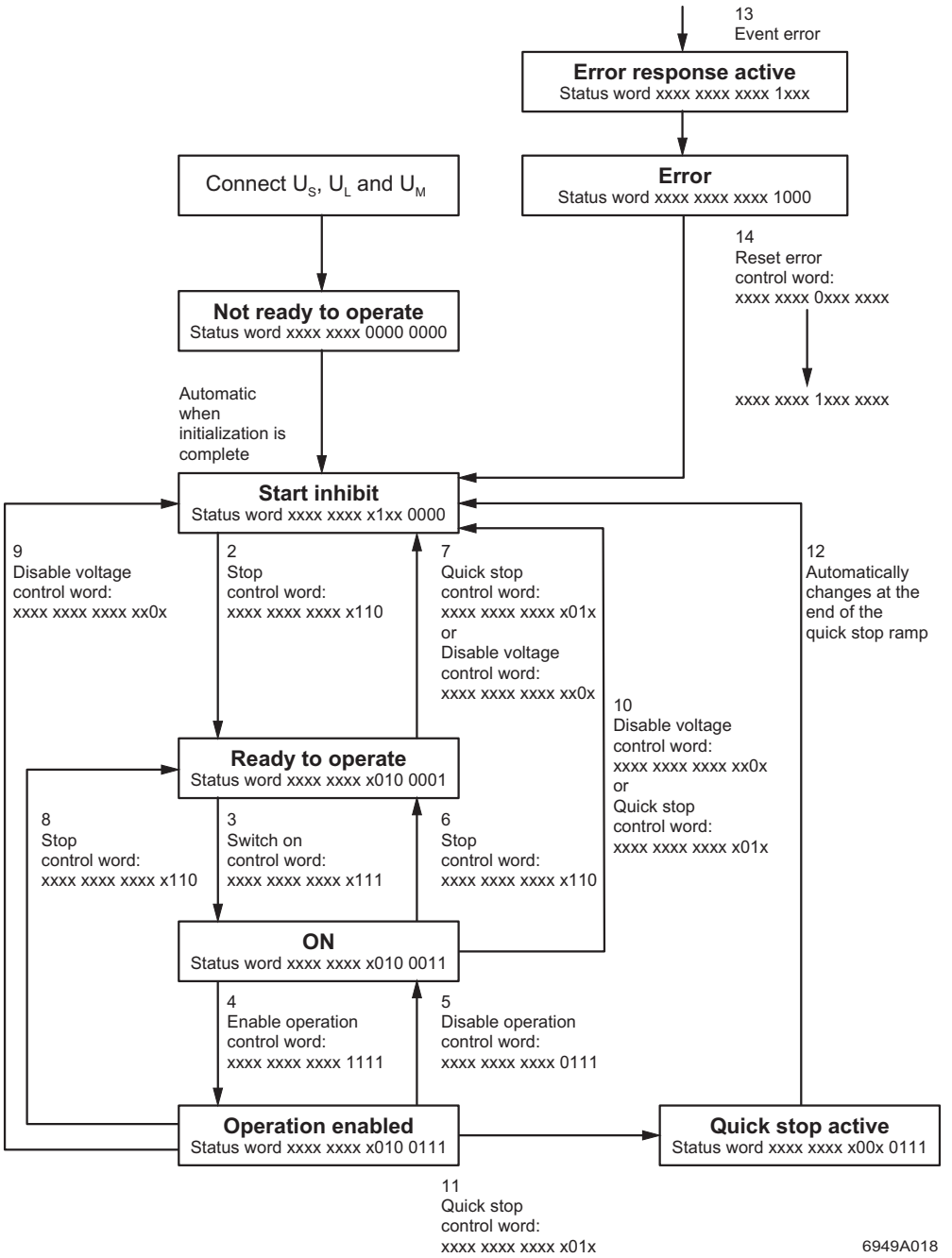

Figure 3-3 Diagram showing the device control states

Table 3-2 Device control states

State/Status	Description
Not ready to operate	In this state, the Inline servo amplifier has just been connected to the supply voltages U_S, U_L, and U_M. The Inline servo amplifier is not able to accept control commands from the bus yet. – The self-test is running. – Initialization is still running. – The power level is disabled. – The drive is disabled. When initialization is complete, the Inline servo amplifier automatically switches to the "Start inhibit" state.
Start inhibit	In this state: – The software and hardware initialization is complete. – The parameterization of the functions with stored values (default values) is complete. – All functions can be parameterized. – The drive is disabled. – The power level is disabled. – Activation of the power level and controller functions is disabled.
Ready to operate	In this state: – The functions can be parameterized. – The drive is disabled. – The power level is disabled.
ON	In this state: – The functions can be parameterized. – The drive is disabled. – The power level is disabled.
Operation enabled	In this state: – Operation is enabled. – The power level and controller functions are activated. – The speed setpoint (or torque setpoint) is processed (the motor can run). – The functions can be parameterized.

Table 3-2 Device control states (Continued)

State/Status	Description
Quick stop active	In this state: – The "quick stop" command was initiated in the "Operation enabled" state. – The drive is slowed down by the quick stop ramp (according to the "SpeedQuickStop" parameter (index $604A_{hex}$) or the "QuickStopTime" parameter (index 6051_{hex})). – The device automatically switches to the "Start inhibit" state at the end of the quick stop ramp.
Error response active	An error occurred and the error response was initiated: the power level is disabled. At the same time, the "ERR" LED lights up and the "Error" bit is set in the control word.
Error	The power level is disabled. The cause of the error can be determined and the error removed in the "Error" state ("ErrorCode" parameter (index $603F_{hex}$)). The device exits the state with the "Reset error" command (see "State Transitions" on page 3-11).

State Transitions

Table 3-3 State transitions

State Transition	Trigger	Description
2, 6, 8	Command: Stop Control word: xxxx xxxx xxxx x110	Command for the transition from various states to the "Ready to operate" state.
3	Command: Switch on Control word: xxxx xxxx xxxx x111	Command for the transition from the "Ready to operate" state to the "ON" state.
4	Command: Enable operation Control word: xxxx xxxx xxxx 1111	Command for the transition to the "Operation enabled" state.
5	Command: Disable operation Control word: xxxx xxxx xxxx 0111	Command for the transition to the "ON" state.
7, 9, 10	Command: Disable voltage Control word: xxxx xxxx xxxx xx0x	Command for the transition to the "Start inhibit" state.
7, 10	Command: Quick stop Control word: xxxx xxxx xxxx x01x	Command for the transition to the "Start inhibit" state.
11	Command: Quick stop Control word: xxxx xxxx xxxx x01x	Command for the transition to the "Quick stop active" state.
12	End of the "Quick stop active" state	The transition is automatic.
13	Event: Error	An error was detected by the drive controller. The event results in the transition to the "Error response active" state.
14	Command: Reset error Control word: xxxx xxxx 0xxx xxxx → xxxx xxxx 1xxx xxxx	Command to acknowledge an error. If no error is detected, the Inline servo amplifier switches to the "Start inhibit" state. The "ERR" LED is switched off and the "Error" bit in the status word is deleted.

3.3 Meaning of the Process Data Words

3.3.1 IN Process Data Words

IN process data word 0 can be used to display various parameters. The "INProcessDataDescription" parameter (index 6000_{hex}) specifies which parameter is displayed. The status word is displayed by default ("StatusWord" parameter, index 6041_{hex}).

IN process data word 1 can be used to display various parameters. The "INProcessDataDescription" parameter (index 6000_{hex}) specifies which parameter is displayed. The speed actual value is displayed by default ("SpeedActualValue" parameter, index 6044_{hex}).

3.3.2 OUT Process Data Words

OUT process data word 0 can be used to transmit various parameters. The "OUTProcessDataDescription" parameter (index 6001_{hex}) specifies which parameter is transmitted. The control word is transmitted by default ("ControlWord" parameter, index 6040_{hex}).

OUT process data word 1 can be used to transmit various parameters. The "OUTProcessDataDescription" parameter (index 6001_{hex}) specifies which parameter is transmitted. The speed setpoint is transmitted by default ("SpeedSetpoint" parameter, index 6042_{hex}).

3.3.3 Parameterizing the Inline Servo Amplifier and Reading Information With PCP

PCP channel

All the parameters for the individual functions are written to or read from the PCP channel via specific indices. Parameters which have been specified using OUT process data words can no longer be written via the PCP channel.

As a lot of parameter data seldom changes or the information is often only required once, data is sent via the PCP channel, which only transmits messages when required. Data is transmitted via PCP communication, whereby a parameter is addressed by an index and is then transmitted via the PCP channel. For every parameter an access attribute specifies whether the parameter can be read or written.

To minimize the number of PCP messages, which must be sent by the higher-level control system to initialize the Inline servo amplifier, the most important parameters are grouped together in "ParameterGroup1" (index $E000_{hex}$) (see Section A 2.4 on page A-33).

3.3.4 Parameterizing the Inline Servo Amplifier via the PCP Channel

PMS Interface

The Inline servo amplifier has a standard PMS interface (**P**eripherals **M**essage **S**pecification) according to DIN 19245-T2. This communication channel provides full access to all the drive parameters of the Inline servo amplifier.

The communication relationship list (CRL) is based on PCP communication. Following power up, it specifies the communication reference (CR) under which a PCP device (e.g., the IB IL DC AR 48/10A) was found by the master and which PMS services this PCP device supports.

Each line in the CRL contains comprehensive information about the connection parameters as well as the CR.

Table 3-4 Connection parameters of the Inline servo amplifier (using the example of INTERBUS)

Communication Reference (CR)	Connection Parameters of the Inline Servo Amplifier		
	Size of the Low Priority Transmit Buffer	Size of the Low Priority Receive Buffer	Supported PMS Services
Automatically determined by the INTERBUS controller board, e.g., 2, 3, 4, etc.	40_{hex} (Maximum length of a PDU in the transmit direction: 64 bytes)	40_{hex} (Maximum length of a PDU in the receive direction: 64 bytes)	0000_{hex} 0000_{hex} 3000_{hex} As Server "Read" and "Write" As client no service Supported services

Object Dictionary (OD)

In order to distinguish between the individual parameters during communication, each parameter has a unique number (index).

The index is listed together with the description of the parameter features in a standardized list, the object dictionary (OD). Each PCP device, which exchanges information via the parameter data channel, has its own object dictionary.

The object dictionary is **not** implemented in the Inline servo amplifier. Please refer to the information in the "Parameters" on page A-1.

PMS Services

The Inline servo amplifier supports several PMS services. However, only the following services are of importance for the parameterization of the Inline servo amplifier:

– "Initiate" (connect)
– "Read"
– "Write"
– "Abort" (disconnect)

No further explanations of other services are given in this user manual.

Additional information can be found in the "Peripherals Communications Protocol (PCP)" User Manual IBS SYS PCP G4 UM E, Order-No. 27 45 16 9.

"Initiate" PCP Service

The "Initiate" PMS service can be used to establish a communication connection between a bus master and the Inline servo amplifier.

The bus master always initiates the connection. Various conditions with regard to the communication connection are checked when establishing a connection, e.g., supported PMS services, user data length, etc. If the connection is established successfully, the Inline servo amplifier responds with a positive initiate response.

If the connection cannot be established, the conditions for the communication connection between the bus master and the Inline servo amplifier have not been met.

If this is the case, compare the configured communication reference list of the bus master with that of the Inline servo amplifier.

The Inline servo amplifier responds with an initiate error response.

Attempting to re-establish an existing communication connection usually results in an "Abort". The communication connection is then aborted and can only be re-established by implementing the "Initiate" PMS service for a third time.

"Read" PCP Service

The "Read" PMS service provides the bus master with read access to all the drive parameters of the Inline servo amplifier. All drive parameters and their meanings are listed in detail in the parameter directory in this manual (see "Parameters" on page A-1).

"Write" PCP Service

The "Write" PMS service provides the bus master with write access to all the drive parameters of the Inline servo amplifier that can be written. In the event of unauthorized access to a drive parameter, the Inline servo amplifier generates a write error response with detailed information about the error cause.

For many parameters a limited value range is used rather than the value range, which is available in theory (e.g., -32768 to 32767 for INT16) for the data type used.

Example

Value range for speed setpoint ("SpeedSetpoint" parameter, index 6042_{hex}): -30000 to 30000 rpm

If a write service is sent with a value outside its value range, but within the INT16 value range, the value that is actually written is limited to the value range of the parameter, but this is not indicated and an error does not occur.

"Abort" PCP Service

The "Abort" PMS service can be used to abort an existing communication connection between the bus master and the Inline servo amplifier. "Abort" is an unconfirmed PMS service and can be initiated by both the bus master and the Inline servo amplifier.

A Parameters

A 1 Structures of Functions

The following diagrams show the structure of the speed and control function, as well as the various monitoring, warning, and error functions.

They describe how the individual parameters are used within the functions.

Structure of the Speed Function

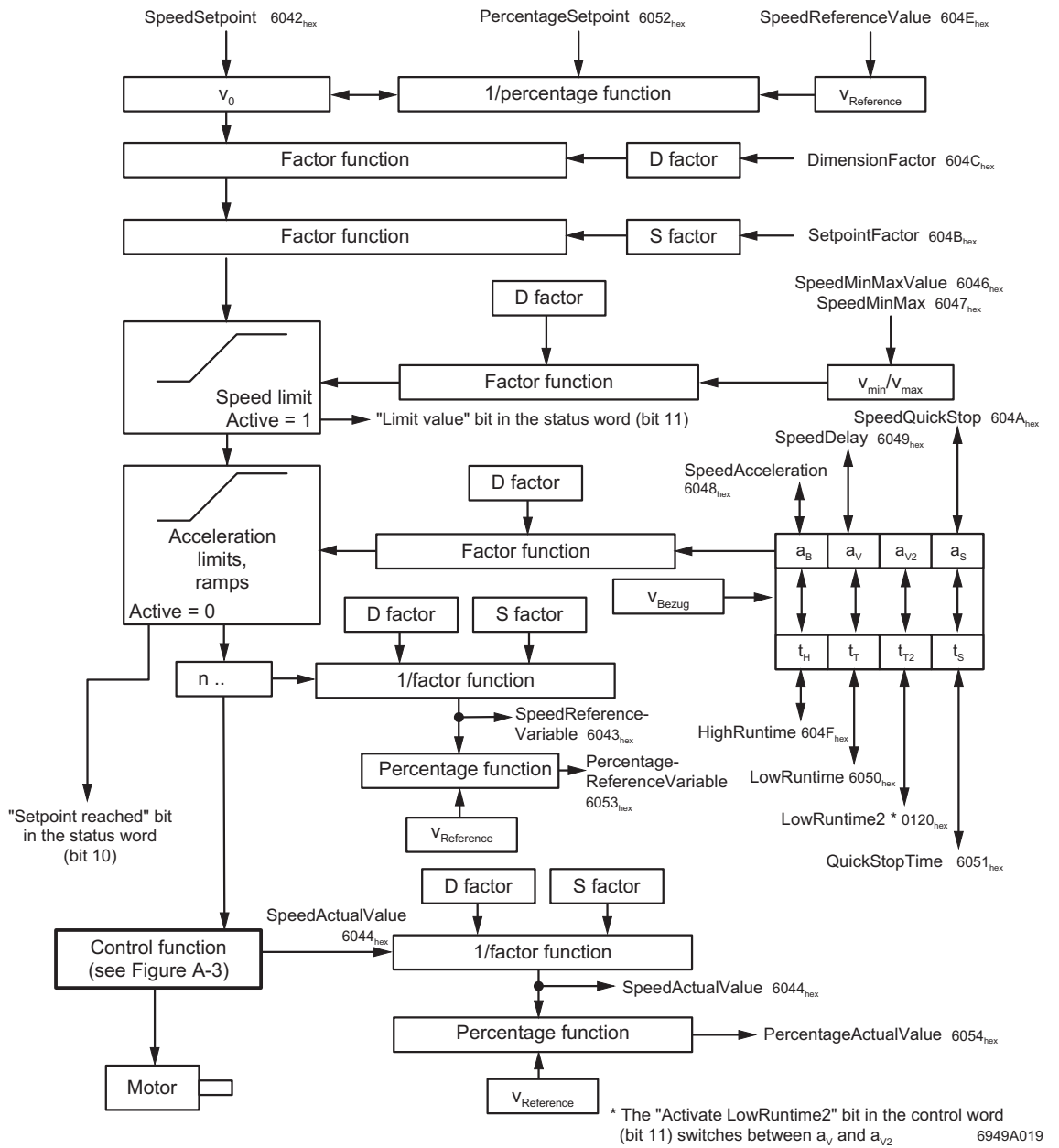

Figure A-1 Speed function

Structure of the Speed Function in Detail

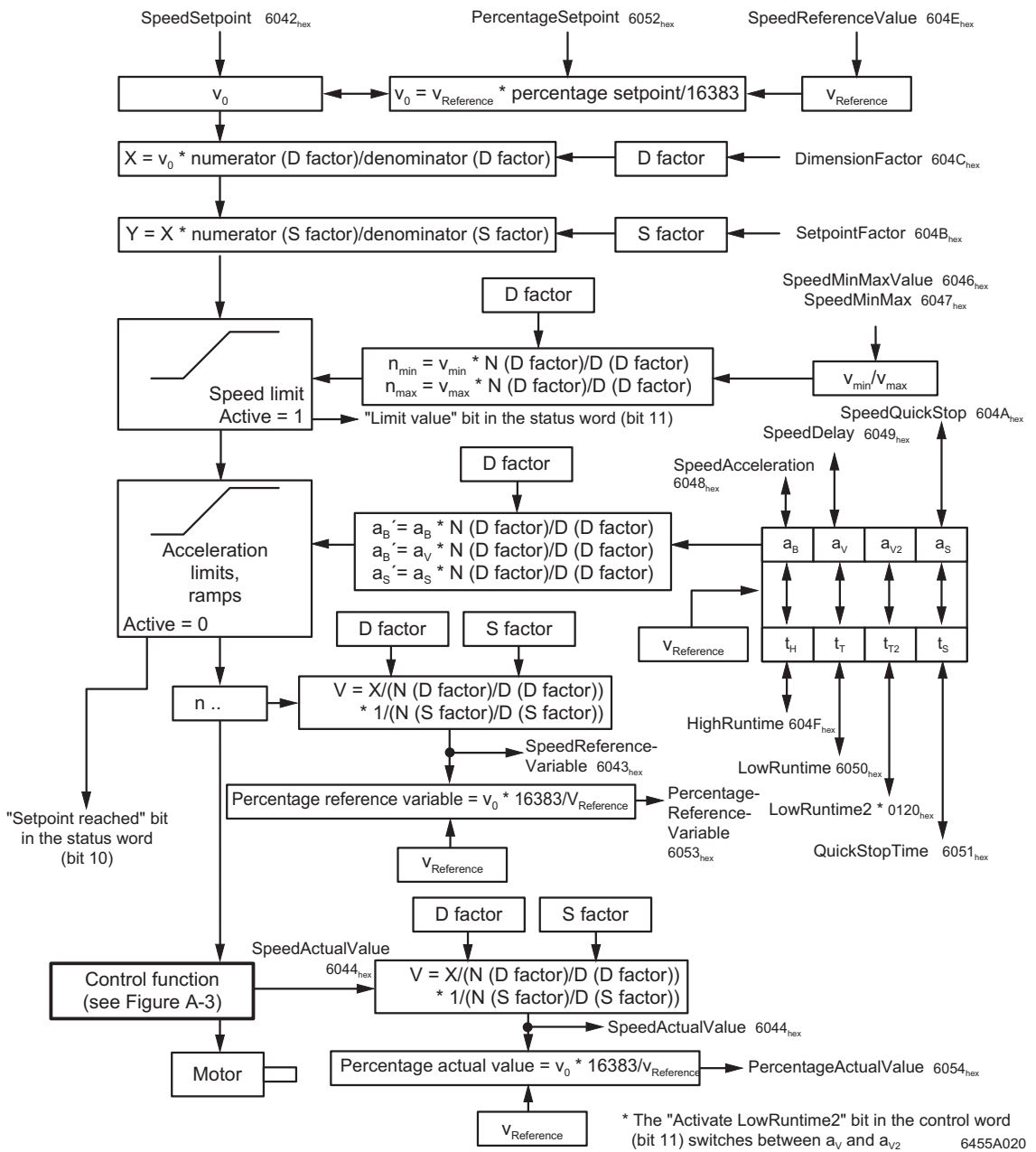

Figure A-2 Speed function in detail

Structure of the Control Function

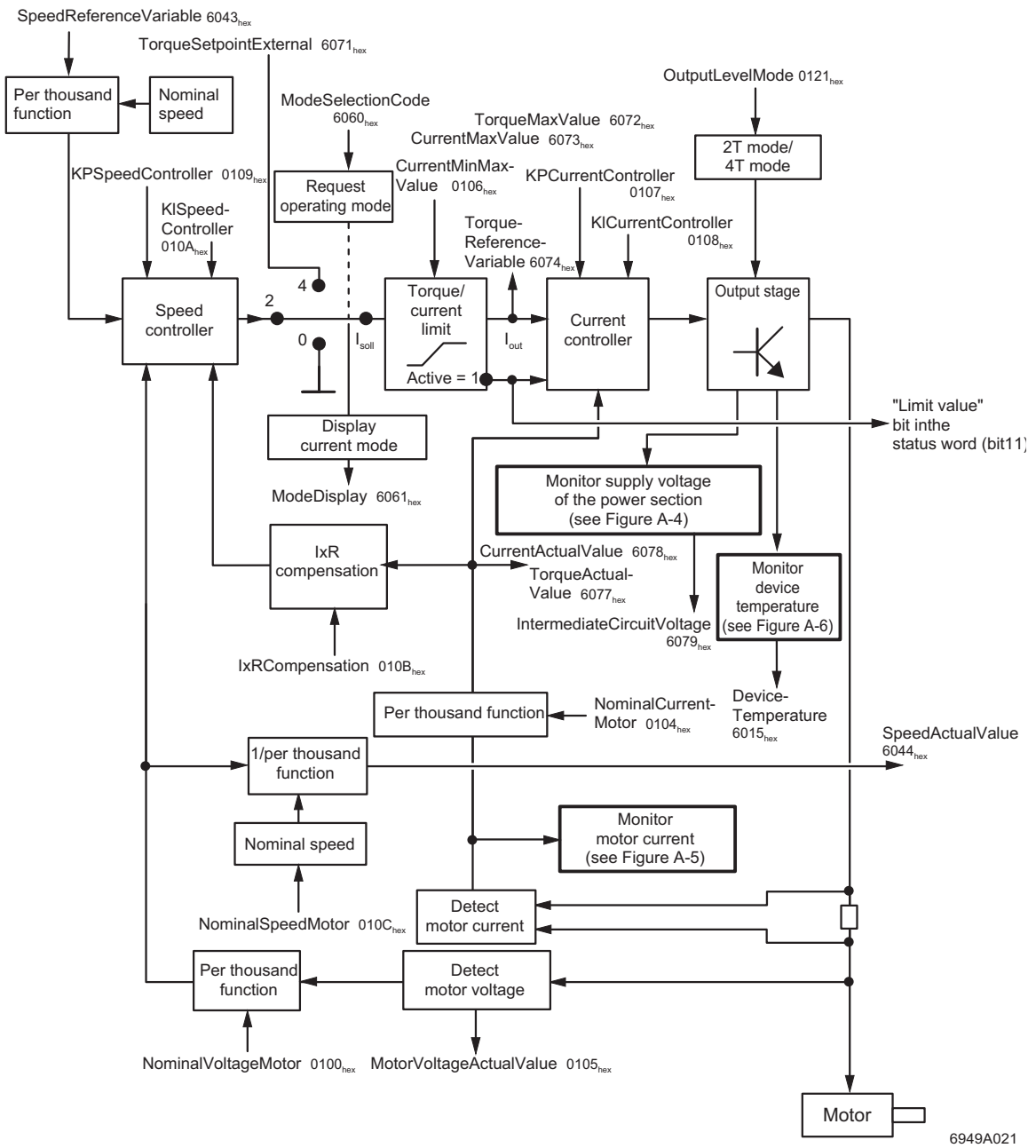

Figure A-3 Control function

Structure for Monitoring the Supply Voltage of the Power Section

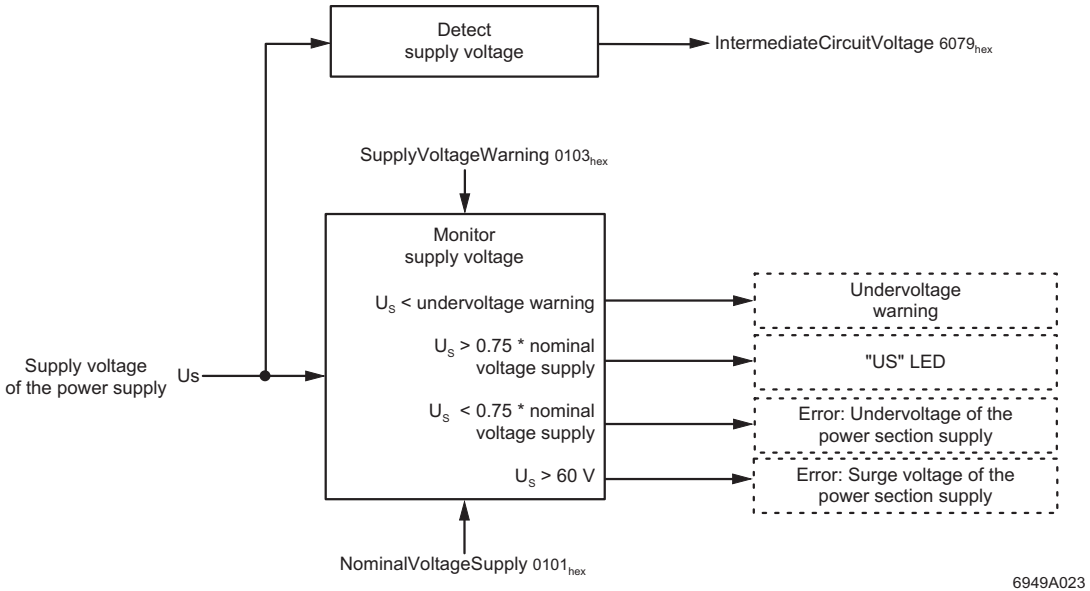

Figure A-4 Monitoring the supply voltage of the power section

Structure for Monitoring the Motor Current

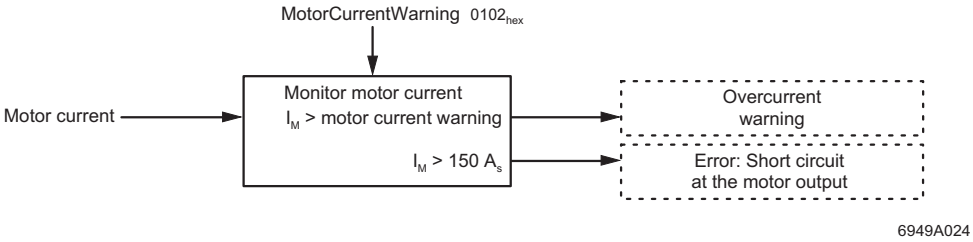

Figure A-5 Monitoring the motor current

Structure for Monitoring the Device Temperature

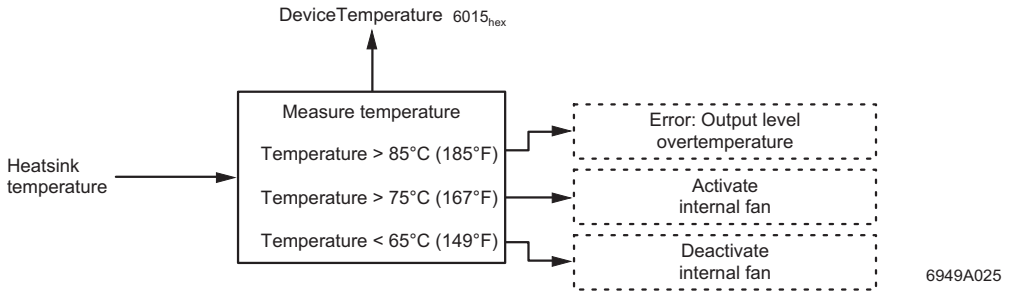

Figure A-6 Monitoring the device temperature

Structure of the Warning Function

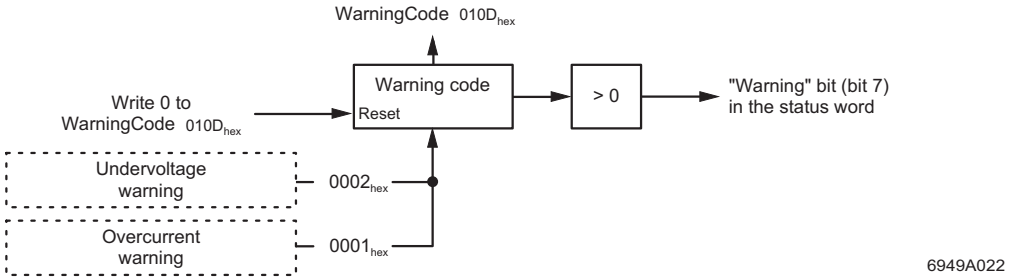

Figure A-7 Warnings

Structure of the Error Function

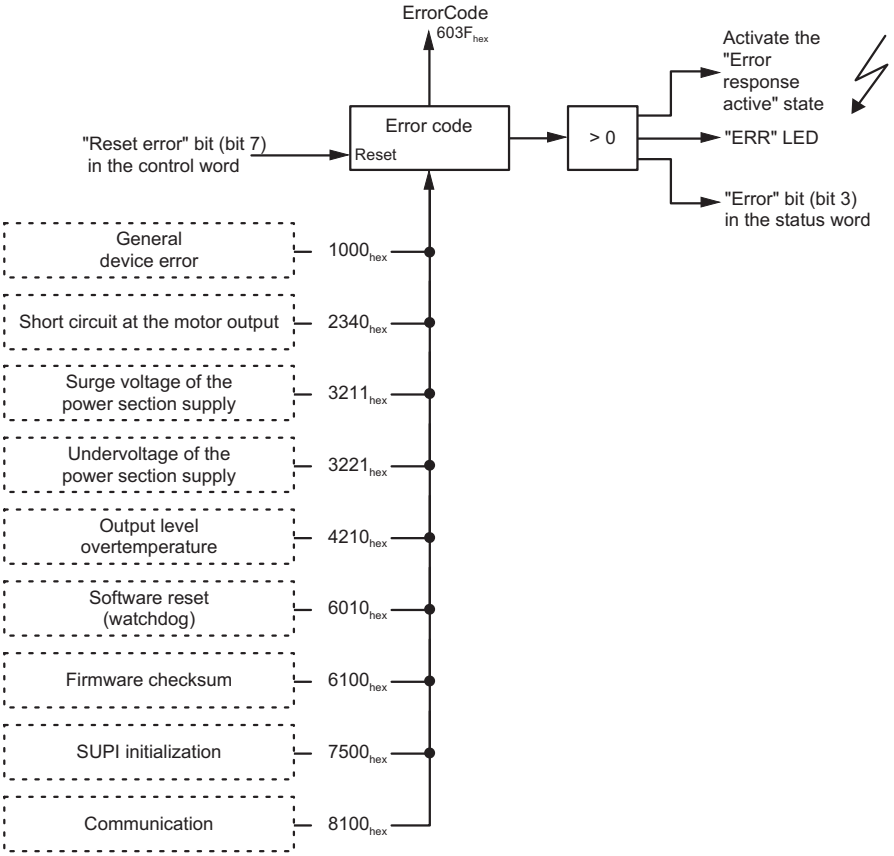

Figure A-8 Errors

A 2 Parameter Lists

Representation of parameters in logical groups

The following tables list the parameters of the Inline servo amplifier in their logical groups (see "Object Dictionary (OD)" on page 3-14).

- The **general device parameters** contain information about the Inline servo amplifier, such as manufacturer information and version number, nominal values of the drive, and the operating mode.
- The **additional parameters in "Speed specification" mode** contain all other information, which is required in addition to the general device parameters for the speed controller function.
- The **additional parameters in "Torque specification" mode** contain all other information, which is required in addition to the general device parameters for the torque and current controller function.
- **Parameter group 1** ("ParameterGroup1", index $E000_{hex}$) groups together twelve indices from the general device parameters and the additional parameters in "Speed specification" mode as subindices.

The "Access" column describes how the parameters can be accessed:

- Read (R)
- Write (W)
- Read and write (RW)

Representation of parameters by their indices

The parameters are also listed according to their indices in Section A 2.5 on page A-34, and their priority is indicated.

A 2.1 General Device Parameters

Table A-1 General device parameters

Index (hex)	Parameter	Object type	Data type	Access	Sub	Length	Unit	Value range	Default value
0001	ManufacturerName	Var	VisibleString	R	01	1 byte per character	–	–	Phoenix Contact GmbH & Co. KG
0002	ManufacturerID	Var	VisibleString	R	01		–	–	00A045
0003	ManufacturerText	Array	VisibleString	R	01		–	–	Connection technology, interface technology, automation
0004	DeviceRange	Var	VisibleString	R	01		–	–	DRIVECOM drive
0006	ProductRange	Var	VisibleString	R	01		–	–	Inline
0007	ProductName	Var	VisibleString	R	01		–	–	IB IL DC AR 48/10A
0008	ProductID	Var	VisibleString	R	01		–	–	2819286
0009	ProductText	Var	VisibleString	R	01		–	–	DC drive controller
000A	OrderNumber	Var	VisibleString	R	01		–	–	2819286
000B	Version	Array[2]			00		–	–	
	Hardware		VisibleString	R	01		–	–	1.20
	Firmware		VisibleString	R	02		–	–	2.00
000C	ManufactureDate	Var	VisibleString	R	01		–	YYYY-MM-DD	2002-08-09
000D	CommunicationProfile	Var	UINT16	R	01	2 bytes	–		6
000E	DeviceProfile	Var	UINT16	R	01	2 bytes	–		0022_{hex}
0100	NominalVoltageMotor	Var	INT32	RW	01	4 bytes	mV	12000 ... 48000	48000
0101	NominalVoltageSupply	Var	INT32	RW	01	4 bytes	mV	12000 ... 48000	12000
0102	MotorCurrentWarning	Var	USIGN32	RW	01	4 bytes	mA	0 ... 10000	10000
0103	SupplyVoltageWarning	Var	USIGN32	RW	01	4 bytes	mV	9000 ... 48000	9000
0105	MotorVoltageActualValue	Var	INT32	R	01	4 bytes	mV	-60000 ... +60000	–
010C	NominalSpeedMotor	Var	USIGN16	RW	01	2 bytes	rpm	100 ... 30000	3000
010D	WarningCode	Var	USIGN16	RW	01	2 bytes	–	0 ... 2	0
0121	OutputLevelMode	Var	INT16	RW	01	2 bytes	–	0: 4T mode 1: 2T mode	0

Table A-1 General device parameters (Continued)

Index (hex)	Parameter	Object type	Data type	Access	Sub	Length	Unit	Value range	Default value
6000	INProcessData-Description	Record	–	RW	00	13 bytes	–	–	–
	ProcessDataLength		USIGN8	RW	01	1 byte	Byte	–	4
	Index 1st parameter		USIGN16	RW	02	2 bytes	–	0000_{hex} ... 6079_{hex}	6041_{hex} (status word)
	Sub-Index 1st parameter		USIGN8	RW	03	1 byte	–	00 ... 09	00
	Index 2nd parameter		USIGN16	RW	04	2 bytes	–	0000_{hex} ... 6079_{hex}	0000_{hex} (status word uses 2 bytes)
	Sub-Index 2nd parameter		USIGN8	RW	05	1 byte	–	00 ... 09	00
	Index 3rd parameter		USIGN16	RW	06	2 bytes	–	0000_{hex} ... 6079_{hex}	6044_{hex} (speed actual value)
	Sub-Index 3rd parameter		USIGN8	RW	07	1 byte	–	00 ... 09	00
	Index 4th parameter		USIGN16	RW	08	2 bytes	–	0000_{hex} ... 6079_{hex}	0000_{hex} (speed actual value uses 2 bytes)
	Sub-Index 4th parameter		USIGN8	RW	09	1 byte	–	00 ... 09	00
6001	OUTProcessData-Description	Record	–	RW	00	13 bytes	–	–	–
	ProcessDataLength		USIGN8	RW	01	1 byte	Byte	–	4
	Index 1st parameter		USIGN16	RW	02	2 bytes	–	0000_{hex} ... 6079_{hex}	6040_{hex} (control word)
	Sub-Index 1st parameter		USIGN8	RW	03	1 byte	–	00 ... 09	00
	Index 2nd parameter		USIGN16	RW	04	2 bytes	–	0000_{hex} ... 6079_{hex}	0000_{hex} (control word uses 2 bytes)
	Sub-Index 2nd parameter		USIGN8	RW	05	1 byte	–	00 ... 09	00
	Index 3rd parameter		USIGN16	RW	06	2 bytes	–	0000_{hex} ... 6079_{hex}	6042_{hex} (speed setpoint)
	Sub-Index 3rd parameter		USIGN8	RW	07	1 byte	–	00 ... 09	00
	Index 4th parameter		USIGN16	RW	08	2 bytes	–	0000_{hex} ... 6079_{hex}	0000_{hex} (speed setpoint uses 2 bytes)
	Sub-Index 4th parameter		USIGN8	RW	09	1 byte	–	00 ... 09	00

Table A-1 General device parameters (Continued)

Index (hex)	Parameter	Object type	Data type	Access	Sub	Length	Unit	Value range	Default value
6002	OUTProcessDataEnable	1 byte	OctetString	RW	01	1 byte	–	00_{hex} ... FF_{hex}	FF_{hex}
6015	DeviceTemperature	Array[1]	INT16	R	01	2 bytes	°C	–	–
603F	ErrorCode	2 bytes	OctetString	R	01	2 bytes	–	0000_{hex} ... 8100_{hex}	–
6040	ControlWord	2 bytes	OctetString	RW	01	2 bytes	–	0000_{hex} ... $FFFF_{hex}$	–
6041	StatusWord	2 bytes	OctetString	R	01	2 bytes	–	0000_{hex} ... $FFFF_{hex}$	–
6060	ModeSelectionCode	Var	INT16	RW	01	2 bytes	–	0: Off 2: Speed specification 4: Torque specification	2
6061	ModeDisplay	Var	INT16	R	01	2 bytes	–	0: Off 2: Speed specification 4: Torque specification	2
6079	IntermediateCircuit-Voltage	Var	USIGN16	R	01	2 bytes	V	0 ... 65	–

Manufacturer-Specific Parameters (Index 0001_{hex} to $000A_{hex}$)

These parameters contain information about the manufacturer and product in the form of strings.

Version (Index $000B_{hex}$)

The "Version" parameter contains the hardware and firmware version.

– Hardware: e.g., "1.20"
– Firmware: e.g., "2.00"

ManufactureDate (Index $000C_{hex}$)

This parameter contains the release date of the current firmware.

CommunicationProfile (Index $000D_{hex}$)

This parameter contains conditions for communication with the module and definitions for communication services and parameters.

DeviceProfile (Index $000E_{hex}$)

The device profile specifies the device functions that are visible via the communication (DRIVECOM profile 22).

NominalVoltageMotor (Index 0100_{hex})

This parameter defines the output voltage of the Inline servo amplifier for the nominal speed of the motor. This motor characteristic value can be found in the data sheet for the motor (see "NominalSpeedMotor (Index $010C_{hex}$)" on page A-13).

NominalVoltageSupply (Index 0101_{hex})

The limit value for the error (U_{Smin}) is derived from the "NominalVoltageSupply" parameter (U_{Sn}).

$U_{Smin} = 0.75 * U_{Sn}$

If the power supply falls below this voltage limit value, an error is indicated.

MotorCurrentWarning (Index 0102_{hex})

If the measured motor current exceeds this limit value, a warning is generated (see "WarningCode (Index $010D_{hex}$)" on page A-13).

SupplyVoltageWarning (Index 0103_{hex})

If the measured supply voltage falls below this limit value, a warning is generated (see "WarningCode (Index $010D_{hex}$)" on page A-13).

MotorVoltageActualValue (Index 0105_{hex})

This parameter contains the current value of the measured motor voltage in millivolts (mV).

NominalSpeedMotor (Index $010C_{hex}$)

This parameter defines the speed at which the motor runs when the nominal motor voltage is applied. This motor characteristic value can be found in the data sheet for the motor (see "NominalVoltageMotor (Index 0100_{hex})" on page A-12).

WarningCode (Index $010D_{hex}$)

Any warnings that are generated are stored in this parameter until they are deleted by writing 0 to the warning code. Unlike errors, warnings have no effect on the operation of the Inline servo amplifier.

Read:

Value	Meaning
0	No warning
1	Motor current has exceeded the value of the "MotorCurrentWarning" parameter (index 0102_{hex})
2	Power supply voltage has fallen below the value of the "SupplyVoltageWarning" parameter (index 0103_{hex})

Write:

Value	Meaning
0	Deletes the warning code

OutputLevelMode (Index 0121_{hex})

Value	Meaning
0	4T mode of the output level: High level of efficiency (for motors with a high current requirement)
1	2T mode of the output level: Lower temperature rise on the motor at a speed of 0 rpm (for small motors with low inductance and a low current requirement)

See also "Operating Modes of the Output Level" on page 1-8.

INProcessDataDescription (Index 6000_{hex})

This parameter defines the parameters that should be accessed via IN process data:

Subindex	Assignment
01	IN process data length (always 4 bytes for the Inline servo amplifier).
02	Index of the parameter, which should be mapped to the IN process data word starting from byte 0.
03	Subindex of the parameter, which should be mapped to the IN process data word starting from byte 0.
04	Index of the parameter, which should be mapped to the IN process data word starting from byte 1. If a 16-bit parameter should be mapped to IN process data word 0, its high byte appears in byte 0 of the IN process data word and its low byte appears in byte 1. In this case, subindex 4 of the IN process data description has the value 0000_{hex}.
05	Subindex of the parameter, which should be mapped to the IN process data word starting from byte 1.
06	Index of the parameter, which should be mapped to the IN process data word starting from byte 2.
07	Subindex of the parameter, which should be mapped to the IN process data word starting from byte 2.
08	Index of the parameter, which should be mapped to the IN process data word starting from byte 3. If a 16-bit parameter should be mapped to IN process data word 1, its high byte appears in byte 2 of the IN process data word and its low byte appears in byte 3. In this case, subindex 8 of the IN process data description has the value 0000_{hex}.
09	Subindex of the parameter, which should be mapped to the IN process data word starting from byte 3.

OUTProcessDataDescription (Index 6001_{hex})

This parameter defines the parameters that should be accessed via OUT process data:

Subindex	Assignment
01	OUT process data length (always 4 bytes for the Inline servo amplifier).
02	Index of the parameter, which should be mapped to the OUT process data word starting from byte 0.
03	Subindex of the parameter, which should be mapped to the OUT process data word starting from byte 0.
04	Index of the parameter, which should be mapped to the OUT process data word starting from byte 1. If a 16-bit parameter should be mapped to OUT process data word 0, its high byte appears in byte 0 of the OUT process data word and its low byte appears in byte 1. In this case, subindex 4 of the OUT process data description has the value 0000_{hex}.
05	Subindex of the parameter, which should be mapped to the OUT process data word starting from byte 1.
06	Index of the parameter, which should be mapped to the OUT process data word starting from byte 2.
07	Subindex of the parameter, which should be mapped to the OUT process data word starting from byte 2.
08	Index of the parameter, which should be mapped to the OUT process data word starting from byte 3. If a 16-bit parameter should be mapped to OUT process data word 1, its high byte appears in byte 2 of the OUT process data word and its low byte appears in byte 3. In this case, subindex 8 of the OUT process data description has the value 0000_{hex}.
09	Subindex of the parameter, which should be mapped to the OUT process data word starting from byte 3.

OUTProcessDataEnable (Index 6002_{hex})

In order to ensure data consistency when switching to the parameters specified in the OUT process data description, these parameters are temporarily separated from the process data before switching over. The value 00_{hex} is written to the "OUTProcessDataEnable" parameter.

Once the "OUTProcessDataDescription" parameter (index 6001_{hex}) has been written, the OUT process data is reenabled by writing the value FF_{hex} to the "OUTProcessDataEnable" parameter (index 6002_{hex}). As long as the parameters specified in the OUT process data description are separated from the process data, their values do not change, even if the OUT process data changes.

DeviceTemperature (Index 6015_{hex})

This parameter displays the current temperature of the output level in °C.

– At temperatures above 85°C (185°F) the Inline servo amplifier switches to the "Error: Output level overtemperature" state.
– At temperatures above 75°C (167°F) the internal fan is activated.
– At temperatures below 65°C (149°F) the internal fan is deactivated.

ErrorCode (Index 603F$_{hex}$)

If an error is detected, the device control enters the "Error response active" state (see Figure 3-3 on page 3-8). Any errors that occur are stored in this parameter until they are deleted with the "Reset error" command.

Error Code (hex)	Cause of the Error	Remedy
0000	No error	–
1000	General device error	Disconnect the Inline servo amplifier. If necessary, replace the Inline servo amplifier.
2340	Short circuit at the motor output	Check the motor cable for short circuits.
3211	Surge voltage of the power section supply	Check the supply voltage of the power section, especially in the event of feedback when braking.
3221	Undervoltage of the power section supply	Check the supply voltage of the power section, especially in the event of higher current loads.
4210	Output level overtemperature	Let the Inline servo amplifier cool down. Observe the current load of the Inline servo amplifier in relation to the current derating curve.
6010	Software reset (watchdog)	Disconnect the Inline servo amplifier. If necessary, replace the Inline servo amplifier.
6100	Firmware checksum	Disconnect the Inline servo amplifier. If necessary, replace the Inline servo amplifier.
7500	SUPI chip initialization	Disconnect the Inline servo amplifier. If necessary, replace the Inline servo amplifier.
8100	Communication	Bus communication was interrupted. Execute the "Reset error" command.

ControlWord (Index 6040_{hex})

This parameter represents the 16-bit DRIVECOM control word. This parameter is written by default via OUT process data word 0. In this case, the control word **cannot** be written via the PCP channel.

Bit assignment:

Bit	Assignment
0	Switch on
1	Disable voltage
2	Quick stop
3	Enable operation
4	–
5	–
6	–
7	Reset error
8	–
9	–
10	–
11	Activate LowRuntime2*
12	–
13	–
14	–
15	–

* As long as bit 11 is set, the "LowRuntime2" parameter (index 0120_{hex}) is used instead of the "LowRuntime" parameter (index 6050_{hex}).
This means that you can switch very quickly between two different braking ramps.

StatusWord (Index 6041_{hex})

This parameter represents the 16-bit DRIVECOM status word. This parameter is read by default via OUT process data word 0.

Bit assignment:

Bit	Assignment
0	Ready to operate
1	ON
2	Operation enabled
3	Error
4	Voltage disabled
5	Quick stop
6	Start inhibit
7	Warning
8	Message (Value: 0)
9	Remote (Value: 1)
10	Setpoint reached
11	Limit value
12	–
13	–
14	–
15	–

ModeSelectionCode (Index 6060_{hex})

This parameter is used to select the operating mode of the Inline servo amplifier.

Value	Meaning
0	Off
2	Speed specification
4	Torque specification

ModeDisplay (Index 6061_{hex})

This parameter is used to read the current mode of the Inline servo amplifier.

Value	Meaning
0	Off
2	Speed specification
4	Torque specification

IntermediateCircuitVoltage (Index 6079_{hex})

This parameter describes the current voltage measured value of the power supply U_S.

A 2.2 Additional Parameters in "Speed Specification" Mode

Table A-2 Additional parameters in "Speed specification" mode

Index (hex)	Parameter	Object type	Data type	Access	Sub	Length	Unit	Value range	Default value
0107	KPCurrentController	Var	USIGN16	RW	01	2 bytes	–	0 ... 65535	200
0108	KICurrentController	Var	USIGN16	RW	01	2 bytes	–	0 ... 65535	30
0109	KPSpeedController	Var	USIGN16	RW	01	2 bytes	–	0 ... 65535	800
010A	KISpeedController	Var	USIGN16	RW	01	2 bytes	–	0 ... 65535	100
010B	IxRCompensation	Var	USIGN16	RW	01	2 bytes	–	0 ... 65535	0
0120	LowRuntime2	Var	USIGN32	RW	01	4 bytes	ms	0 ... 4294967294	1
6042	SpeedSetpoint	Var	INT16	RW	01	2 bytes	rpm	-30000 ... +30000	0
6043	SpeedReferenceVariable	Var	INT16	R	01	2 bytes	rpm	–	–
6044	SpeedActualValue	Var	INT16	R	01	2 bytes	rpm	–	–
6046	SpeedMinMaxValue	Array[2]	–	RW	00	8 bytes	–	–	–
	SpeedMinValue		USIGN32	RW	01	4 bytes	rpm	0 ... 30000	0
	SpeedMaxValue		USIGN32	RW	02	4 bytes	rpm	0 ... 30000	30000
6047	SpeedMinMax	Array[4]			00	16 bytes	–	–	–
	SpeedMinPos		USIGN32	RW	01	4 bytes	rpm	0 ... 30000	0
	SpeedMaxPos		USIGN32	RW	02	4 bytes	rpm	0 ... 30000	30000
	SpeedMinNeg		USIGN32	RW	03	4 bytes	rpm	0 ... 30000	0
	SpeedMaxNeg		USIGN32	RW	04	4 bytes	rpm	0 ... 30000	30000
6048	SpeedAcceleration	Record	–	RW	00	6 bytes	–	–	–
	DeltaSpeed		USIGN32	RW	01	4 bytes	rpm	1 ... 1000000	2000
	DeltaTime		USIGN16	RW	02	2 bytes	s	0 ... 1000	1
6049	SpeedDelay	Record	–	RW	00	6 bytes	–	–	–
	DeltaSpeed		USIGN32	RW	01	4 bytes	rpm	1 ... 1000000	2000
	DeltaTime		USIGN16	RW	02	2 bytes	s	0 ... 1000	1
604A	SpeedQuickStop	Record	–	RW	00	6 bytes	–	–	–
	DeltaSpeed		USIGN32	RW	01	4 bytes	rpm	1 ... 1000000	5000
	DeltaTime		USIGN16	RW	02	2 bytes	s	0 ... 1000	1

Table A-2 Additional parameters in "Speed specification" mode (Continued)

Index (hex)	Parameter	Object type	Data type	Access	Sub	Length	Unit	Value range	Default value
604B	SetpointFactor	Array[2]	–	RW	00	4 bytes	–	–	–
	Numerator		INT16	RW	01	2 bytes	–	-10000 ... +10000	1
	Denominator		INT16	RW	02	2 bytes	–	-10000 ... +10000 (without 0)	1
604C	DimensionFactor	Array[2]	–	RW	00	8 bytes	–	–	–
	Numerator		INT32	RW	01	4 bytes	–	-100000 ... +100000	1
	Denominator		INT32	RW	02	4 bytes	–	-100000 ... +100000 (without 0)	1
604E	SpeedReferenceValue	Var	USIGN32	RW	01	4 bytes	rpm	0 ... 30000	1000
604F	HighRuntime	Var	USIGN32	RW	01	4 bytes	ms	1 ... 1000000	500
6050	LowRuntime	Var	USIGN32	RW	01	4 bytes	ms	1 ... 1000000	500
6051	QuickStopTime	Var	USIGN32	RW	01	4 bytes	ms	1 ... 1000000	200
6052	PercentageSetpoint	Var	INT16	RW	01	2 bytes	–	-32766 ... +32766 (16383 = 100%)	0%
6053	PercentageReference-Variable	Var	INT16	R	01	2 bytes	–	–	–
6054	PercentageActualValue	Var	INT16	R	01	2 bytes	–	16383 = 100%	–

KPCurrentController (Index 0107_{hex})

This parameter contains the proportional factor of the PI filter of the current controller (see "Adjusting Control Parameters" on page 1-12).

KICurrentController (Index 0108_{hex})

This parameter contains the integral factor of the PI filter of the current controller (see "Adjusting Control Parameters" on page 1-12).

KPSpeedController (Index 0109_{hex})

This parameter contains the proportional factor of the PI filter of the speed controller (see "Adjusting Control Parameters" on page 1-12).

KISpeedController (Index $010A_{hex}$)

This parameter contains the integral factor of the PI filter of the speed controller (see "Adjusting Control Parameters" on page 1-12).

IxRCompensation (Index $010B_{hex}$)

This parameter contains the IxR compensation factor of the speed controller (see "Adjusting Control Parameters" on page 1-12).

LowRuntime2 (Index 0120_{hex})

Together with the "SpeedReferenceValue" parameter (index $604E_{hex}$), this parameter is used to define the steepness of braking ramp 2. "LowRuntime2" (braking ramp 2, index 0120_{hex}) replaces "LowRuntime" (braking ramp, index 6050_{hex}), as long as the "Activate LowRuntime2" bit is set (bit 11 of the control word). This means that you can switch very quickly between two different braking ramps.

For the "LowRuntime2" parameter:

Braking ramp 2 = Speed reference value/LowRuntime2

SpeedSetpoint (Index 6042_{hex})

The "SpeedSetpoint" parameter is the default value for the speed at the motor axis or at the load. It is multiplied by the dimension factor ("DimensionFactor" parameter, index $604C_{hex}$) and the setpoint factor ("SetpointFactor" parameter, index $604B_{hex}$).

If the servo amplifier is to be supplied with other units (e.g., m/s or m/min), the dimension factor is used for adjustments.

Multiplying the speed setpoint by the dimension factor converts the speed setpoint into rpm, if the dimension factor equals 1.

SpeedReferenceVariable (Index 6043_{hex})

The speed reference variable is the speed from the ramp function standardized to the speed setpoint unit.

SpeedActualValue (Index 6044_{hex})

The speed actual value is the speed at the motor axis or load standardized to the speed setpoint unit. It is calculated from the measured motor voltage ("MotorVoltageActualValue" parameter, index 0105_{hex}) using the "NominalVoltageMotor" parameter (index 0100_{hex}) and the "NominalSpeedMotor" parameter (index $010C_{hex}$).

SpeedMinMaxValue (Index 6046_{hex})

This parameter is used to limit the speed between the minimum and maximum speed (see "SpeedMinMax (Index 6047_{hex})" on page A-25).

As it is given as a value, the speed limits apply to both the positive and negative direction.

Subparameters

The "SpeedMinMaxValue" parameter consists of the "SpeedMinValue" and "SpeedMaxValue" subparameters.

When writing, the "SpeedMaxValue" subparameter is internally mapped to the "SpeedMaxPos" and "SpeedMaxNeg" values.

When writing, the "SpeedMinValue" subparameter is internally mapped to the "SpeedMinPos" and "SpeedMinNeg" values.

The unit of speed depends on the dimension factor and corresponds to the speed setpoint unit (index 6042_{hex}).

SpeedMinMax (Index 6047_{hex})

This parameter is used to limit the motor speed between the minimum and maximum speed (positive and negative working area).

Subparameters

The "SpeedMinMax" parameter consists of the "SpeedMinPos", "SpeedMaxPos", "SpeedMinNeg", and "SpeedMaxNeg" subparameters (see Figure A-9).

When writing this parameter, the "SpeedMinPos" subparameter is mapped to the "SpeedMinValue" subparameter (index 6046_{hex}), and the "SpeedMaxPos" subparameter is mapped to the "SpeedMaxValue" subparameter (index 6046_{hex}).

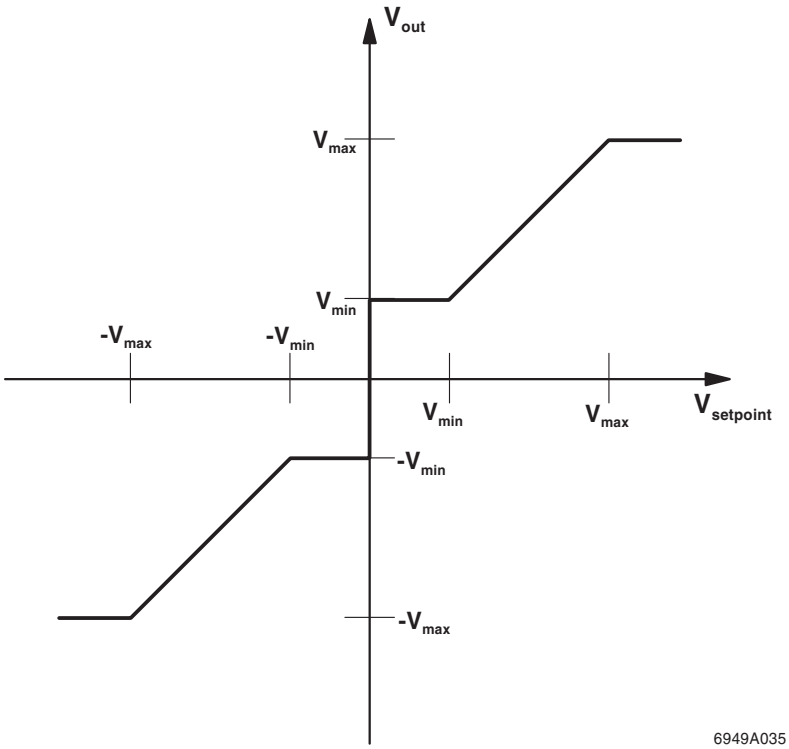

Figure A-9 Speed limitation using "SpeedMinMax" (index 6047_{hex})

SpeedAcceleration (Index 6048_{hex})

Subparameters

The Inline servo amplifier calculates the acceleration ramp using the "DeltaSpeed" and "DeltaTime" subparameters:

Acceleration ramp = Delta speed/delta time

The "DeltaSpeed" unit depends on the dimension factor and corresponds to the speed setpoint unit (index 6042_{hex}).

When writing this parameter, the "HighRuntime" parameter (index $604F_{hex}$) is overwritten using the "SpeedReferenceValue" parameter (index $604E_{hex}$).

SpeedDelay (Index 6049_{hex})

Subparameters

The Inline servo amplifier calculates the braking ramp using the "DeltaSpeed" and "DeltaTime" subparameters:

Braking ramp = Delta speed/delta time

The "DeltaSpeed" unit depends on the dimension factor and corresponds to the speed setpoint unit (index 6042_{hex}).

When writing this parameter, the "LowRuntime" parameter (index 6050_{hex}) is overwritten using the "SpeedReferenceValue" parameter (index $604E_{hex}$).

SpeedQuickStop (Index $604A_{hex}$)

Subparameters

The Inline servo amplifier calculates the quick stop ramp using the "DeltaSpeed" and "DeltaTime" subparameters:

Quick stop ramp = Delta speed/delta time

The "DeltaSpeed" unit depends on the dimension factor and corresponds to the speed setpoint unit (index 6042_{hex}).

When writing this parameter, the "QuickStopTime" parameter (index 6051_{hex}) is overwritten using the "SpeedReferenceValue" parameter (index $604E_{hex}$).

SetpointFactor (Index $604B_{hex}$)

Subparameters

The "SetpointFactor" parameter consists of a "Numerator" subparameter and a "Denominator" subparameter, and is calculated as follows:

Setpoint factor = Numerator/denominator

The setpoint factor is used to change the resolution and the setting range of the setpoint specification. It is only included in the setpoint specification and the output variables of the speed function.

DimensionFactor (Index $604C_{hex}$)

The dimension factor enables the use of units other than rpm (revolutions per minute) outside the Inline servo amplifier.

The Inline servo amplifier uses the dimension factor to convert:

– All **incoming** values to rpm
– All **outgoing** values back to the original unit

The dimension factor is used to:

– Determine a gear factor
– Standardize values for frequencies or user-specific units

It affects the following variables:

– Setpoint specification
– Speed limitation
– Ramp function
– Output variables for the speed function

Subparameters

The "DimensionFactor" parameter consists of a "Numerator" subparameter and a "Denominator" subparameter, and is calculated as follows:

Dimension factor = Numerator/denominator

The dimension factor describes the relationship between the "NominalSpeedMotor" parameter (index $010C_{hex}$) and the "SpeedReferenceValue" parameter (index $604E_{hex}$).

Example

The dimension factor for a drive with a speed reference value of v = 800 mm/s and a motor with a nominal speed of n = 3000 rpm is as follows:

D = 3000 rpm/800 mm/s (numerator = 3000, denominator = 800, setpoint factor = 1)

SpeedReferenceValue (Index 604E$_{hex}$)

This parameter is the speed reference value and is used to calculate percentage values and ramps.

The unit of speed depends on the dimension factor and corresponds to the speed setpoint unit (index 6042$_{hex}$).

HighRuntime (Index 604F$_{hex}$)

This parameter writes the acceleration ramp using the high runtime from zero to the speed reference value (index 604E$_{hex}$).

Acceleration ramp = Speed reference value/high runtime

When writing this parameter, the "SpeedAcceleration" parameter (index 6048$_{hex}$) is written with an appropriately converted value. The "DeltaTime" subparameter is set to 1 s.

LowRuntime (Index 6050$_{hex}$)

This parameter writes the braking ramp using the low runtime from the speed reference value (index 604E$_{hex}$) to zero.

Braking ramp = Speed reference value/low runtime

When writing this parameter, the "SpeedDelay" parameter (index 6049$_{hex}$) is written with an appropriately converted value. The "DeltaTime" subparameter is set to 1 s.

QuickStopTime (Index 6051$_{hex}$)

This parameter writes the quick stop ramp using the quick stop time from the speed reference value (index 604E$_{hex}$) to zero.

Quick stop ramp = Speed reference value/quick stop time

When writing this parameter, the "SpeedQuickStop" parameter (index 604A$_{hex}$) is written with an appropriately converted value. The "DeltaTime" subparameter is set to 1 s.

PercentageSetpoint (Index 6052_{hex})

This parameter writes the speed setpoint as a percentage of the speed reference value (index $604E_{hex}$).

A value of 16383 is equal to 100%, i.e., the value range is between -200% and +200% of the speed reference value.

PercentageReferenceVariable (Index 6053_{hex})

This parameter writes the current value of the reference variable for the internal speed controller as a percentage of the speed reference value (index $604E_{hex}$).

A value of 16383 is equal to 100%, i.e., the value range is between -200% and +200% of the speed reference value.

PercentageActualValue (Index 6054_{hex})

This parameter writes the current speed actual value as a percentage of the speed reference value (index $604E_{hex}$).

A value of 16383 is equal to 100%, i.e., the value range is between -200% and +200% of the speed reference value.

A 2.3 Additional Parameters in "Torque Specification" Mode

Table A-3 Additional parameters in "Torque specification" mode

Index (hex)	Parameter	Object type	Data type	Access	Sub	Length	Unit	Value range	Default value
0104	NominalCurrentMotor	Var	USIGN32	RW	01	4 bytes	mA	0 ... 10000	10000
0106	CurrentMinMaxValue	Array[2]	–	RW	00	4 bytes	–	–	–
	CurrentMinValue		USIGN16	RW	01	2 bytes	‰	0 ... 65535	0
	CurrentMaxValue		USIGN16	RW	02	2 bytes	‰	0 ... 65535	1000
6071	TorqueSetpointExternal	Var	INT16	RW	01	2 bytes	‰	-32768 ... +32767	0
6072	TorqueMaxValue	Var	USIGN16	RW	01	2 bytes	‰	0 ... 65535	1000
6073	CurrentMaxValue	Var	USIGN16	RW	01	2 bytes	‰	0 ... 65535	1000
6074	TorqueReferenceVariable	Var	INT16	R	01	2 bytes	‰	-32768 ... +32767	–
6076	NominalTorqueMotor	Var	USIGN16	RW	01	2 bytes	0.1 Nm	1 ... 1000	100 * 0.1 = 10
6077	TorqueActualValue	Var	INT16	R	01	2 bytes	‰	–	–
6078	CurrentActualValue	Var	INT16	R	01	2 bytes	‰	–	–

NominalCurrentMotor (Index 0104_{hex})

This parameter is the reference value for calculating the current actual value ("CurrentActualValue" parameter, index 6078_{hex}) and the torque actual value ("TorqueActualValue" parameter, index 6077_{hex}) on the basis that the torque is proportional to the motor current.

CurrentMinMaxValue (Index 0106_{hex})

Subparameters

The "CurrentMinValue" and "CurrentMaxValue" subparameters are used to limit the motor current between these values, as long as the setpoint is not equal to zero (see Figure A-10).

The universal limit of 10 A can never be exceeded.

When writing the "CurrentMaxValue" **subparameter**, the "CurrentMaxValue" parameter (index 6073_{hex}) is overwritten.

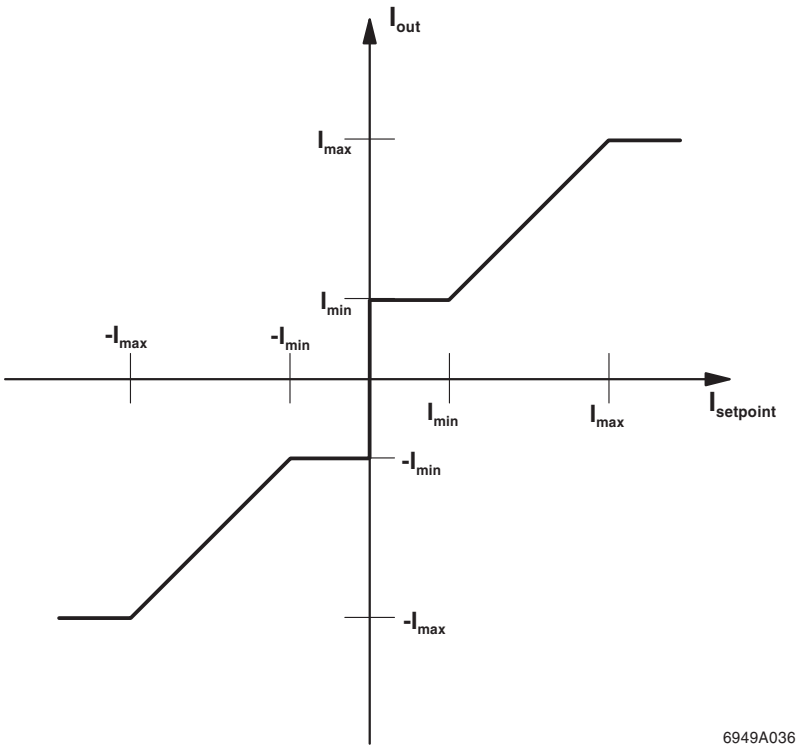

Figure A-10 Method of operation of the current limiter (Input variable $I_{setpoint}$, reference variable I_{out})

TorqueSetpointExternal (Index 6071_{hex})

This parameter writes the relative setpoint for "Torque specification" mode as a per thousand value of the "NominalTorqueMotor" parameter (index 6076_{hex}).

TorqueMaxValue (Index 6072_{hex})

This parameter specifies the maximum value of the motor torque as a per thousand value of the nominal torque and is used to limit the motor torque.

This parameter has the same effect as the "CurrentMaxValue" parameter (index 6073_{hex}).

CurrentMaxValue (Index 6073_{hex})

This parameter specifies the maximum value of the motor current as a per thousand value of the nominal current and is used to limit the motor current.

When writing this parameter, the "CurrentMaxValue" **subparameter** (index 0106_{hex}, subindex 02) is overwritten.

TorqueReferenceVariable (Index 6074_{hex})

This parameter writes the current value of the torque reference variable as a per thousand value of the "NominalTorqueMotor" parameter (index 6076_{hex}).

NominalTorqueMotor (Index 6076_{hex})

This parameter writes the nominal torque of the motor that is being used.

TorqueActualValue (Index 6077_{hex})

This parameter writes the current motor torque as a per thousand value of the "NominalTorqueMotor" parameter (index 6076_{hex}).

CurrentActualValue (Index 6078_{hex})

This parameter writes the current motor current as a per thousand value of the "NominalCurrentMotor" parameter (index 0104_{hex}).

A 2.4 ParameterGroup1 (Index $E000_{hex}$)

Table A-4 ParameterGroup1 (index $E000_{hex}$)

Index (hex)	Parameter	Object type	Data type	Access	Sub	Length	Unit	Value range	Default value
E000	ParameterGroup1	Record	–	RW	00	38 bytes	–	–	–
	NominalVoltageMotor (see index 0100_{hex})		INT32	RW	01	4 bytes	mV	12000 ... 48000	48000
	NominalVoltageSupply (see index 0101_{hex})		INT32	RW	02	4 bytes	mV	12000 ... 48000	12000
	KPCurrentController (see index 0107_{hex})		USIGN16	RW	03	2 bytes	–	0 ... 65535	200
	KICurrentController (see index 0108_{hex})		USIGN16	RW	04	2 bytes	–	0 ... 65535	30
	KPSpeedController (see index 0109_{hex})		USIGN16	RW	05	2 bytes	–	0 ... 65535	800
	KISpeedController (see index $010A_{hex}$)		USIGN16	RW	06	2 bytes	–	0 ... 65535	100
	IxRCompensation (see index $010B_{hex}$)		USIGN16	RW	07	2 bytes	–	0 ... 65535	0
	LowRuntime2 (see index 0120_{hex})		USIGN32	RW	08	4 bytes	ms	0 ... 4294967294	1
	SpeedReferenceValue (see index $604E_{hex}$)		USIGN32	RW	09	4 bytes	rpm	0 ... 30000	1000
	HighRuntime (see index $604F_{hex}$)		USIGN32	RW	10	4 bytes	ms	0 ... 1000000	500
	LowRuntime (see index 6050_{hex})		USIGN32	RW	11	4 bytes	ms	0 ... 1000000	500
	QuickStopTime (see index 6051_{hex})		USIGN32	RW	12	4 bytes	ms	0 ... 1000000	200

A 2.5 Representation of Parameters by Their Indices

Index (hex)	Parameter	Priority*	See
0001	ManufacturerName		page A-12
0002	ManufacturerID		page A-12
0003	ManufacturerText		page A-12
0004	DeviceRange		page A-12
0006	ProductRange		page A-12
0007	ProductName		page A-12
0008	ProductID		page A-12
0009	ProductText		page A-12
000A	OrderNumber		page A-12
000B	Version		page A-12
000C	ManufactureDate		page A-12
000D	CommunicationProfile		page A-12
000E	DeviceProfile		page A-12
0100	NominalVoltageMotor	1	page A-12
0101	NominalVoltageSupply	1	page A-12
0102	MotorCurrentWarning		page A-12
0103	SupplyVoltageWarning		page A-12
0104	NominalCurrentMotor	1	page A-31
0105	MotorVoltageActualValue		page A-13
0106	CurrentMinMaxValue		page A-31
0107	KPCurrentController	2	page A-23
0108	KICurrentController	2	page A-23
0109	KPSpeedController	2	page A-23
010A	KISpeedController	2	page A-23
010B	IxRCompensation	2	page A-23
010C	NominalSpeedMotor	1	page A-13
010D	WarningCode		page A-13
0120	LowRuntime2	2	page A-23
0121	OutputLevelMode	2	page A-13
6000	INProcessDataDescription		page A-14
6001	OUTProcessDataDescription		page A-16
6002	OUTProcessDataEnable		page A-16
6015	DeviceTemperature		page A-16
603F	ErrorCode		page A-17
6040	ControlWord		page A-18

Index (hex)	Parameter	Priority*	See
6041	StatusWord		page A-19
6042	SpeedSetpoint		page A-23
6043	SpeedReferenceVariable		page A-24
6044	SpeedActualValue		page A-24
6046	SpeedMinMaxValue		page A-24
6047	SpeedMinMax		page A-25
6048	SpeedAcceleration	2	page A-26
6049	SpeedDelay	2	page A-26
604A	SpeedQuickStop	2	page A-26
604B	SetpointFactor		page A-27
604C	DimensionFactor		page A-27
604E	SpeedReferenceValue	1	page A-28
604F	HighRuntime	2	page A-28
6050	LowRuntime	2	page A-28
6051	QuickStopTime	2	page A-28
6052	PercentageSetpoint		page A-29
6053	PercentageReferenceVariable		page A-29
6054	PercentageActualValue		page A-29
6060	ModeSelectionCode	1	page A-20
6061	ModeDisplay		page A-20
6071	TorqueSetpointExternal		page A-32
6072	TorqueMaxValue		page A-32
6073	CurrentMaxValue		page A-32
6074	TorqueReferenceVariable		page A-32
6076	NominalTorqueMotor		page A-32
6077	TorqueActualValue		page A-32
6078	CurrentActualValue		page A-32
6079	IntermediateCircuitVoltage		page A-20
E000	ParameterGroup1		page A-33

* Priority 1: These parameters must be set for the device to operate correctly.

Priority 2: These parameters can be set to optimize drive function.

No priority: These parameters are only set for special functions, not for normal operation.

B Technical Appendix

B 1 Technical Data

General Data	
Order Designation	IB IL DC AR 48/10A
Order No.	28 19 28 6
Housing dimensions (width x height x depth)	48 mm x 85 mm x 166 mm (1.890 x 3.346 x 6.535 in.)
Housing material	PA 6.6; black, anodized aluminum
Heatsink material	Aluminum
Weight (typical)	460 g
Permissible temperature (operation)	-25°C to +55°C (-13°F to +131°F)
Permissible temperature (storage/transport)	-25°C to +85°C (-13°F to +185°F)
Permissible humidity (operation)	75% permanent, 85% occasionally
Permissible humidity (storage/transport with unused interfaces [standard packaging])	75% permanent, 85% occasionally

For a short period, slight condensation may appear on the outside of the housing if, for example, the module is brought into a closed room from a vehicle.

Permissible air pressure (operation)	80 kPa to 106 kPa (up to 2000 m [6562 ft.] above sea level)
Permissible air pressure (storage/transport)	70 kPa to 106 kPa (up to 3000 m [9843 ft.] above sea level)
Degree of protection	IP20 according to DIN 40050
Class of protection	Class 3 according to VDE 0106, IEC 60536

Mechanical Requirements	
Vibration test sinusoidal vibrations according to IEC 60068-2-6; EN 60068-2-6	2g load, 2 hours in each space direction
Shock test according to IEC 60068-2-27, EN 60068-2-27	25g for 1 ms, three shocks in each space direction
Free fall according to IEC 60068-2-32	1 m (3.281 ft.)

Power Supply	
Status indicators	US LED
Connection method	2-pos. COMBICON connector
Supply voltage U_S	12 V DC to 48 V DC ±15%
Supply current	0 A to 10 A
Surge voltage shutdown	U_S > 60 V DC

Outputs	
Number	1
Connection	1 permanently excited DC motor with brushgears
Connection method	3-pos. COMBICON connector with shield clamp
Output voltage	± supply voltage U_S, maximum Mean value 92% of U_S, maximum
Motor cable	2-wire, shielded
Continuous current	10 A, maximum (see "Selecting Compatible Motors" on page 2-10)
Starting current	10 A, maximum
Motor current limiting	0 A to 10 A (can be set via bus)
Maximum motor voltage	±65 V DC
Function	4 quadrant servo controller
Braking	Energy fed back to the power supply unit (brake chopper may be required)
Minimum motor inductance	200 µH at U_S = 48 V DC 100 µH at U_S = 24 V DC

Cycle Time of the Internal Digital Controllers	
Speed controller	1 ms
Torque/current controller	250 µs

Electrical Isolation	
Logic U_L / I/O / motor	500 V AC test voltage

Pulse Wide Modulation (PWM)	
Clock frequency	20 kHz

Interfaces	
Local bus	Inline potential jumper
Communications power U_L	7.5 V DC (via potential jumper)
Current consumption at U_L	45 mA, typical
Module supply U_M	24 V DC (via potential jumper)
Current consumption at U_M	65 mA, typical

Approvals	
CE	Yes
UL	Applied for

Conformance With EMC Directive 89/336/EEC		
Conformance is only ensured if the shielded motor cable is connected to the FE terminal and the module is connected to functional earth ground via the DIN rail.		
Noise Immunity Test According to EN 50082-2:1995		
Electrostatic discharge (ESD)	EN 61000-4-2:1995/ IEC 61000-4-2	Criterion B 6 kV contact discharge 8 kV air discharge
Electromagnetic fields	EN 61000-4-3:1993/ IEC 61000-4-3	Criterion A Field strength: 10 V/m
Fast transients (burst)	EN 61000-4-4:1995/ IEC 61000-4-4	Criterion B Supply lines: 2 kV Signal/data lines: 2 kV Criterion A Interfaces: 1kV
Conducted interference	EN 61000-4-6:1993/ IEC 61000-4-6	Criterion A, test voltage 10 V
Noise Emission Test According to EN 50081-2:1993		
Noise emission of housing	EN 55011:1991	Class A

B 2 Ordering Data

Description	Order Designation	Order No.
Inline servo amplifier for DC motors, with COMBICON connectors	IB IL DC AR 48/10A	28 19 28 6
Positioning CPU as the positioning control system for multi-axis point-to-point control systems, with connectors and labeling fields	IB IL POS 200-PAC	28 61 82 3
Positioning CPU as the positioning control system for multi-axis point-to-point control systems, without connectors and labeling fields	IB IL POS 200	28 19 33 8
Four standard connectors and one shield connector are required for the complete fitting of the IB IL POS 200 terminal.		
Connector with eight terminals, spring-cage connection (green, w/o color print); pack of 10	IB IL SCN-8	27 26 33 7
Connector with six terminals, spring-cage connection and shield connection (green, w/o color print); for RS-232 connecting cable; pack of 10	IB IL SCN-6 SHIELD	27 26 35 3
"IB IL POS 200 (-PAC) Positioning CPU" User Manual	IB IL POS 200 UM E	26 98 08 3
"Configuring and Installing the INTERBUS Inline Product Range" User Manual	IB IL SYS PRO UM E	27 43 04 8

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